Enel

L'ENERGIA CHE TI ASCOLTA.

Porto Romano – Energy Complex
Thermal Power Plant
Environmental Impact Assessment Study

Porto Romano - Energy Complex

- Thermal Power Plant
- Marine Facilities
- Power Line to Tirana 2
- Power Line to Italy

Thermal Power Plant

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Environmental Impact Assessment Study

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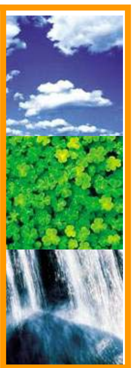

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1. PREAMBLE

This Environmental Impact Assessment Study is related to a new Thermal Power Plant proposed by ENEL, the main electric Italian company, in the industrial area in Porto Romano (Durrës Region, Albania).

The proposed Thermal Power Plant is part of the Project called "Energy Complex" including:

- the thermal Power Plant;
- a Pier, 950 m long, which is used to receive coal and to ship the byproducts from the plant (gypsum, ash);
- a 400 kV power line, about 25 km long, which connects a new power station to Tirana 2 National Grid Power Station;
- a 500 kV DC undersea cable, about 210 km long, which connects a new AC/DC conversion power station to Italy.

The Power Plant, the Pier, the Power Line, the Undersea Cable and annexed facilities have been analyzed in four separated EIS.

Scope of the present document is to analyze the Thermal Power Plant project.

The proposed site is located in a flat land about 10 km North of Durrës , in an area designated by the Albanian Government to industrial uses.

The new Thermal Power Plant is coal fired and is made of two units, 800 MWe each, to be built in two stages.

The Porto Romano Thermal Power Plant has been designed according to the Best Available Techniques applicable to this kind of Large Combustion Plant.

The flue gas treatment system includes SCR - Selected Catalytic Reduction - denitrification system, fabric filter for dust removal, gas cooling unit and desulphurization plant. Flue gases will be discharged into the atmosphere through a stack 150 m high, for each unit.

The plant will be provided with a dedicated area where a Post Combustion Carbon Capture and Segregation System might be installed.

The water needed by the plant is taken from the sea and treated for all process uses.

The cooling system will use sea water, circulating in open cycle.

The plant has been designed in order to reduce raw water intake for industrial uses and related discharge. Waste water streams will be collected, sent to the waste water treatment plants and finally discharged to the sea, in compliance with relevant regulatory requirements.

1.1. PROPONENT PROFILE: ENEL

Enel is Italy's largest power company and Europe's second listed utility by installed capacity. It produces, distributes and sells electricity and gas across Europe, North and Latin America. Further to the acquisition of the Spanish utility Endesa, together with partner Acciona, Enel has now a presence in 21 countries with 75,500 MW of generating capacity (on December 31st, 2007) and serves more than 50 million power and gas customers. Listed on the Milan stock exchange since 1999, Enel has the largest number of shareholders of any Italian company, at some 1.7 million retail and institutional investors.

Enel is also the second-largest Italian operator in the natural gas market, with approximately 2.5 million customers and a 10% market share in terms of volumes. The company has 73,500 employees and operates a wide range of hydroelectric, thermoelectric, nuclear, geothermal, wind-power and photovoltaic power stations.

Enel was the first utility in the world to replace its customers' traditional electromechanical meters with modern electronic devices that make it possible to take meter readings in real time and manage contractual relationships remotely. This innovation has enabled Enel to implement time-of-use electricity charges, which offer customer savings for evening and weekend electricity use, an initiative that has attracted interest from many utilities around the world.

1.1.1. *International Operations*

After having completed the sale of non-strategic assets, Enel is actively engaged in international expansion in the power and gas market. With approximately 30,000 MW in plants using renewable energy resources (hydro, geothermal, wind, solar, biomass and cogeneration) across the world, Enel is a world leader in the sector.

For the next five years (2008-2012) Enel is investing 7.4 billion euros for the development of renewable energy sources and for research and development of new environmental friendly technologies.

Enel is strongly focused on international growth and has a presence in Europe (Bulgaria, France, Greece, Italy, Romania, Russia, Slovakia and Spain), North America (Canada and the United States) and Latin America (Brazil, Chile, Costa Rica, El Salvador, Guatemala, Mexico and Panama). With Endesa, Enel will also be present in Argentina, Colombia, Morocco, Peru and Portugal.

Enel runs operations in Spain with Enel Union Fenosa Renovables, a company active in the wind, hydro and cogeneration power sector.

In early October 2007, Enel and partner Acciona successfully completed their Joint Tender Offer over Endesa, Spain's first utility. Enel and Acciona currently hold 92% of the share capital of Endesa (Enel 67%, Acciona 25%).

Enel is one of the largest renewable independent operators in the Americas with Enel North America and Enel Latin America, two companies that have over 1,100 MW of installed capacity.

In North America Enel has 470 MW of hydroelectric, wind and biomass power generation and has just signed an agreement with the company TradeWind Energy in the US to develop over 1,000 MW of new wind power. In March 2007, Enel, through its subsidiary Enel North America, announced the acquisition of AMP Resources. The acquisition includes one operating and four advanced stage geothermal development projects expected to add approximately 150 MW of capacity over the next four years to Enel's North American operations, as well as access to a number of future opportunities.

In Latin America Enel operates 660 MW of hydroelectric and wind power plants. Enel Latin America also runs operations in El Salvador in the geothermal field.

In France, Enel has acquired Erelis, a company that has authorizations in several different fields to build wind plants of up to 500 MW. Moreover, it has signed a Memorandum of Understanding with Edf to acquire 12.5% of the new nuclear power project European Pressurized Reactor (EPR). Enel owns 5% of the French power stock exchange Powernext and is one of the main operators in energy trading in the country with 1,000 MW exchanged in 2006.

In Bulgaria, Enel acquired control of one of the country's largest power plants, Maritza East III, in March 2003. The lignite-fired facility has a capacity of 840 MW.

In Slovakia, in February 2005, Enel acquired 66% of Slovenské Elektrárne (SE), the largest electricity generator in the country, and the second-largest in Central and Eastern Europe, with a generation capacity of 6,000 MW, a mix of nuclear, thermal and hydro assets.

In Romania, in April 2005, it acquired 51% of two electricity distribution companies: Enel Distributie Banat and Enel Distributie Dobrogea, which supply 1.4 million customers. Further to the acquisition of Electrica Muntenia Sud, finalized on 5 June 2008, the electricity distribution company operating in the Bucarest area, Enel doubled its presence in Romania, reaching about 2.5 million customers.

In Russia, Enel managed from June 2004 to September 2007 – in partnership with the local private group ESN Energo – the North-West Thermal Power Plant in St. Petersburg. Enel has also acquired from the ESN Group 49.5% of RusEnergoSbyt, a Russian trader providing electricity to major industrial customers. On April 4, 2007, Enel acquired through SeverEnergia (former Enineftegaz, a consortium 40% Enel - 60% Eni) a group of promising gas fields including 100% of OAO Articgaz, 100% of ZAO Urengoil, 100% of OAO Neftegaztechnologiya. Currently, Enel owns 55.8% of JCS Fifth Generation Company of the Wholesale Electricity Market ("OGK-5").

1.1.2. *Shareholding Structure*

The Italian Economy Ministry holds 21.1% of the company directly and another 10.1% indirectly through state-run lender Cassa Depositi e Prestiti, leaving a free-float of some 68.8%. Thanks to its Code of Ethics, Sustainability Report, its environmental protection policy and the adoption of international best practices for transparency and corporate governance, Enel's shareholders include leading international investment funds, insurance companies and pension funds, ethical funds, along with Italian retail investors.

1.2. ENVIRONMENTAL PERMITTING PROCEDURE

The legal framework for the EIA procedure in Albania is provided by Law No. 8990 on *Environmental Impact Assessment*, approved on January 23, 2003.

The procedure for the Environmental Assessment can be summarized in the following two phases:

- Local Approval
- MoEFWA Approval

The purpose of the *Local Approval* phase appears to be the acquisition by MoEFWA of the formal "*no objection*" statement by the local government (the Municipality of Katund i Ri) and of the formal evaluation of the EIA by REA, with possible prescriptions.

The sequence of activities and the timing for this phase are specified in the Decision n. 994, dated 02.07.2008, and are summarized as follows:

1. Proponent submits to REA and local government (Municipality) the project documentation (Summary of technical project and EIA) for approval.
2. The Mayor organizes a discussion with the local public concerned (within 5 days).
3. The Mayor issues a formal document with the Municipality approval and transmits such document to MoEFWA (with the local public discussion record).
4. REA (within 5 days) conducts initial review of documentation presented by Proponent; potential request of additional documentation (the review by REA does not start until the Proponent submits the requested additional documentation).
5. REA (within 20 days) conducts field inspections, consults Local government units, prepares written justified opinion about the project and sends it to MoEFWA.

The purpose of the *MoEFWA Approval* phase appears to be the compliance with the principles of the AArhus convention (ratified by Albania with Law n. 8672 dated 26.10.2000). Scope of the evaluation by MoEFWA of the EIA, is to issue the Environmental Permit and define the relevant prescriptions for the Proponent.

The sequence of activities and the timing for this phase are specified in the Law n. 8990, dated 23.01.2003 and in the Decision n. 994, dated 02.07.2008, and are summarized as follows:

1. MoEFWA receives the project documentation from REA with its formal opinion.
2. MoEFWA starts the revision process, involving the Ministerial Commission.
3. The Commission submits its report within 3 months from REA opinion transmission.
4. The local government and MoEFWA promote a consultation with "public concerned":
   - Local Government (Municipality) and MoEFWA inform general public concerned.
   - The information is published continuously for 20 days, without interruption (on local radios and televisions, on the web page of the public body, on daily and periodic press (if possible), on the information stands of local government unit(s). This last requirement is mandatory .The information must include the indication of the place where the project documentation is deposited for consultation, the deadline for submitting comments (minimum one month form the last day of the publications), and the date and venue for the public debate.
   - The public debate with the [general] public concerned (note: population, associations, NGOs, etc.) includes experts from MoEFWA, the proponent

with the certified experts who have prepared the EIA, and experts from the relevant Ministries.

- MoEFWA's experts keep the minutes of the public debate, recording suggestion, remarks and proposals from the public.
- MoEFWA incorporates the remarks in the draft permit.

5. MoEFWA makes the appropriate decision about the project and releases the environmental declaration or permit, within 5 days from submission of the Commission report.

1.3. ENVIRONMENTAL IMPACT ASSESSMENT SCOPE AND CRITERIA

The *Environmental Impact Study* has been developed according to the specific requirements set by the *Albanian Regulation on EIA (Law n. 8990 issued on 23/01/2003)* and to the guidelines applicable to environmental impact studies (*Directive 85/337/CEE*, integrated by *EU Directive 97/11/CE* and *2003/35/CE*; *the World Bank Operational Procedures 4.01*).

In the *Environmental Impact Assessment Study*, the description of the existing situation for each environmental component covers an area of 5 km radius centred in the *Power Plant* site (*Investigated area*). For particular components the extension can be different: for example for the Atmosphere the area is wider (40x40 km), while for Noise it is smaller (about 2 km).

The *investigated area* is presented in *Figure 1.3a.*

Beside the present *Introduction*, the *Environmental Impact Assessment Study* includes:

- *Motivation of the Proposed Project*, in which are presented an Albanian energy market overview and presented the main choices of the project;
- *Legal Framework*, in which main regulations relevant for the specific project are presented;
- *Project Description*, which presents a description of the *Power Plant* project, including alternative technologies considered, resources use, emissions and waste;
- *Environmental Baseline*, which includes the identification of the investigated area and the description of the existing baseline for each environmental component potentially impacted by the project;
- *Impact Assessment*, in which the potential impacts on the environment due to the project are evaluated qualitatively and/or quantitatively; whenever necessary, for major impacts, the evaluation is carried out also using scientific forecasting models;
- *EIA Matrix,* that summarize the impacts analysed in the *Environmental Impact Assessment Study;*
- *Monitoring Plan*, which describes the monitoring devices foreseen in order to control the plant and its effects on the environment.

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2. MOTIVATION OF THE PROPOSED PROJECT

2.1. ALBANIAN ELECTRICITY MARKET

Over the past few years, Albania maintained macroeconomic stability as well as relatively high rates of economic growth (see *Table 2.1a)*.

But Albania shows a high weakness in the energy sector. In particular, in 2002 a slowdown on economic growth was caused by electricity shortage and floods.

Table 2.1a Economic Growth in Albania

	2001	2002	2003	2004	2005	2006
GDP growth (annual %)	7.0	2.9	5.7	5.9	5.5	5.0
GDP (current USD mil)	4,091	4,456	5,617	7,380	8,380	9,136
Inflation, GDP deflator (annual %)	3.46	3.30	3.38	6.01	3.49	2.39
Population total (ths)	3,066	3,078	3,094	3,112	3,130	3,138
Population growth (annual %)	0.15	0.37	0.52	0.58	0.58	0.25
Unemployment rate (%)	15	13.2	15	14.4	14.1	13.9
Energy imports, net (% of energy use)	60.8	60.3	56.9	58.6	..	..
Electric power consumption (kWh per capita)	1,159	1,460	1,311	1,200	..	..

However electricity shortages remain an obstacle for economic development. No new energy plant has been built in the last 15 years.

Electricity remains relatively expensive for many consumers.

In Albania 99% of the total electricity output is generated by hydropower plants, however only 30% of the hydro potential is used.

The main hydropower plants are using the river flow to generate electricity and have no water storage capacity: there is a high dependency on hydrological condition in power generation. In fact if river flow decrease, e.g. for a reduction of rainfall, decrease power generation and availability of electricity on internal market.

The following Table resume main figures on Albanian electricity market.

Table 2.1b Albanian Electricity Market

	2004	2005	Change (%)
Installed Capacity (MW)	1,659	1,659	0
Gas fired Thermoelectric	0	0	0
Coal fired Thermoelectric	54	54	0
Nuclear	0	0	0
Hydroelectric	159	159	0
Other RES	1,446	1,446	0
Annual Production (GWh)	5,491.10	5,486.00	-0.0928
Gas fired Thermoelectric	0	0	0
Coal fired Thermoelectric	0	0	0
Nuclear	0	0	0
Hydroelectric	5,389.00	5,391.01	0.0374
HFO fired Thermoelectric	78.00	74.99	-1.3342
Other RES	26.10	20.00	-23.3628
Imports (GWh)	478.52	503.96	0.0532
Exports (GWh)	0	0	0
Consumption (GWh)	5,969.62	5,989.96	0.3407
Peak demand (GWh)	1,250	1,290	3.2000

In the peak months of December and January (1,3 GWh) the power system covers only 85-90% of the total power consumption, leading to blackouts.

Albania imports part of the electricity needed from neighboring countries (Macedonia, Kosovo and Greece), but the import is limited by the low capacity of the power lines.

At present a new thermal power plant (98 MW) in under construction in Vlore and new power lines to connect Albania with neighboring countries are expected, as shown in following *Table 2.1c*.

Table 2.1c New Power Lines Foreseen in Albania

Capacity	Route	Length	Year of completion
400 kV	Podgorica (Montenegro) – Tirana (Albania)	156 km	2008
400 kV	Tirana – Elbasan (Albania)	45 km	2008
220 kV	Fier – Vlore (Albania)	26 km	Completed
400 kV	Zemlak (Albania) – Bitola (Macedonia)	85 km	In negotiation
400 kV	Prishtina (Kosovo) – Tirana (Albania)	238 km	In negotiation

2.2. OBJECTIVES OF THE PROPOSED PROJECT

Main scope of the proposed Project is to build a new plant in order to improve Albanian power generation development, using an energy source common and cheap, able to support the Albanian economic development and improve the existing critical situation.

The following *Table 2.2a* presents the foreseen electric energy consumptions growth in Albania.

Table 2.2a Electricity Total Consumption Growth (GWh)

	Actual		Forecast		Growth
	2005	2010	2015	2020	Rate (%)
Total Consumption	6,695	7,802	9,391	12,490	4.2

In June 2003, the Ministry of Industry and Energy, through the National Agency of Energy in collaboration with other institutions, adopted a *National Energy Strategy* for the Country.

The related document analyses the necessary changes that should occur in order to increase the security of energy supply and to optimize energy resources in Albania, therefore meeting the demand and achieving a sustainable economic development for the Country in the future.

The Strategy adopted by the Government identified priority investments (based on expected demand growth and impact of energy conservation measures), financing needs and required reforms for the sector (including those set out in the Power Sector Policy Statement - World Bank, 2005).

The main problems, which have been identified and underlined through the analysis, are related to the existing situation on the supply and production side; in particular:

- current generation capacity is insufficient to meet the existing demand; as a consequence, the electricity supplied to costumers is partially interrupted;
- technical losses in the transmission-distribution network are still high;
- electric interconnection with neighboring countries includes three lines, with low capacity.

According to the above described situation, the following three strategies have been identified:

- increase of production capacity;
- replacement of low-exergy services, including electricity saving;
- extension of transmission and distribution systems.

With reference to the latter issue, KESH (Albania Power Corporation), in close cooperation with Group of Donors and ENEL, has prepared an Investment Plan, in order to reduce the losses and increase the extension of the transmission and distribution systems.

Due to these investments, the improvement of generation, transmission and distribution systems is ongoing and many projects are under development.

Therefore, the proposed project becomes part of the national energy strategy adopted by the Government, aimed at improving Albania's power transmission and distribution system, with the goal to ensure power supply to the population, trade and industry.

The construction and operation of a new transmission line will bring benefits, both direct and indirect, to the country economy, as well as social and economic opportunities for the local communities directly affected by Project development. The major social and economic benefits identified are:

- infrastructures and services upgrading;
- country and local economic growth opportunities.

Since the project will improve electricity generation and the exchange capacity with neighboring countries, it represents also an important and valuable partnership between Albania and European companies operating in the power sector.

2.2.1. *The "Clean Coal" Option*

The proposed project appears as the main option to increase Albanian electric generation capacity at acceptable economic and environmental costs.

The availability of coal in many countries in the world and its reserves, which are far greater than those of hydrocarbons, makes it an economically advantageous fuel and strategically vital in a balanced mix of primary sources used for the production of electric energy.

Moreover, from an ecological point of view, the adoption of the most modern emission capture technologies and the higher efficiency of the plants make the use of coal compatible with environmental regulations.

Enel's policy to make the use of coal "clean" is based on three main lines of action:

- correct and safe fuel management;
- increase in thermodynamic efficiency;
- forced reduction in polluting emissions.

Correct and Safe Fuel Management

It is planned that coal will be handled using entirely closed and automated structures, which minimize dispersion of dust. The mineral, which arrives at the power plant by ship, is taken from the holds by a closed conveyor belt, which carries it directly to the deposits, partially protected with wind breakers (soil embankment eventually with plants) and equipped with devices to control dust dispersion (e.g. water sprinklers).

The combustion ashes, extracted by fabric filters, are collected in silos and, therefore, transferred again, using a sealed automatic system, to the holds of the ships for transport to sites for reuse. In fact, ashes are by-products of the plant, recovered and reused in cement works as raw materials for the production of cement and as inert matter for concrete.

In addition, the gypsum produced in the desulphurisers, another by-product of the plant, extracted and filtered, is temporarily stored in a shed, equipped with automatic, remote controlled machinery for unloading and subsequent recovery for transport to the areas of use.

Increase in Thermodynamic Efficiency

It is planned that ultra-supercritical coal dust boilers will be adopted, which will enable an increase of the thermodynamic performance of the new *Power Plant* of at least 7 percentage points (from 38% to about 45%) if compared to a traditional plant.

Coal pulverisation is the most widespread combustion technique and is undergoing further developments; the use of particular burners decreases the emission of pollutants at start-up, also in the combustion chamber.

With ultrasupercritical technology (USC), the temperature of the steam generated in the boiler can be driven up to more than 600 °C and the pressure to about 280 bar, by means of high innovative materials for the boiler, the steam turbine and the main components of the thermodynamic cycle.

Practically, the process parameters are driven to the technical limits compatible with the available technologies, with the result that the higher system efficiency allows also a considerable fuel saving (and, therefore, emissions and by-products reduction) at equivalent electricity production.

Forced Reduction in Polluting Emissions

The latest generation fabric filters are used to prevent the dispersion of dust present in the flue gas into the atmosphere. The operating principle is simple and is more or less the same as for ordinary vacuum cleaner bags. However, the type and number of bags and the materials used make the system particularly effective for filtering fine dust.

The particulate removal efficiency is very high, around 99.9%.

New high efficiency catalytic fume denitrification systems are planned for the reduction of nitrogen oxides (NOx), based on the chemical reaction between NOx, ammonia and oxygen and the presence of "selective catalysts". The nitrogen oxide reduction efficiency is higher than 85%.

Advanced limestone/gypsum-type desulphurisation systems are used for the reduction of sulphur oxides (SOx). Very briefly, the system can be compared to a large "shower" in which the combusted gases are washed by a jet of water enriched with limestone in solution. The calcium carbonate contained in the mix reacts with the sulphur oxides in addition of air, giving pure gypsum as final product, perfectly suitable to be reused for constructions.

The system achieves a reduction efficiency of 95%.

In conclusion, it is really possible to talk about the "clean" use of coal, since the adopted technologies enable an emissions reduction.

2.2.2. CO_2 *Capture and Sequestration*

Fossil fuels (oil, natural gas, coal) are extracted from the earth. When they are subject to combustion processes in order to produce energy, the carbon which is inside them reacts with the oxygen of the air forming carbon dioxide (CO_2), which is considered one of the main responsible for greenhouse effect.

It is possible to capture the carbon dioxide produced in power plants and send it back into the deepest layers of the earth, confining it there for ever.

Research centres and industrial operators all over the world are working at identifying the best system to do this. In particular there are many research projects in progress in the United States and in the European Union.

After the CO_2 has been captured it can be confined in geological formations, such as the already exploited deposits of oil and gas and the deep saline aquifer folds.

These geological formations offer a huge storage capacity, which is sufficient to confine the world's man made CO_2 emissions for tens and possible hundreds of thousands of years.

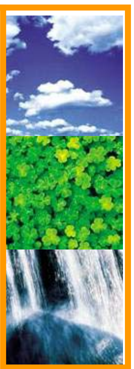
Enel is committed in experimental projects aimed at the industrial demonstration of the technology for capturing CO_2 released from conventional fossil fuel power plants and holding it geologically. The project design foresees a plant for smokes treatment with a capacity of 600 thousand cubic metres/hour, therefore capable of capturing part of the overall load of smokes produced by a 600 MW thermoelectric unit and separating the CO_2.

Before the plant is built, laboratory research will be carried out and a pilot circuit will be installed in one of Enel's existing plants.

Regarding the geological holding of CO_2 the Italian National Institute of Geology and Vulcanology (INGV) is carrying out a feasibility study to determine the geological, hydrogeological, geochemical and geomechanic properties of an ideal site.

In the meantime, while waiting for the results of relevant research investments, Enel is already adopting a CO_2 capturing and holding system which can contribute to the reduction of emissions on a small but not negligible scale.

In the Porto Romano Thermal Power Plant a suitable area will be dedicated to an eventual future installation of a Carbon Dioxide Capture Plant, once this technology will be ready for industrial scale applications.



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3. LEGAL, REGULATORY AND POLICY FRAMEWORK

3.1. INTRODUCTION

This chapter provides an overview of the following issues:

- Generalities on Albanian institutional and legislative framework
- Albanian laws, decisions and international conventions relevant to environmental protection;
- Albanian legislation on environmental impact assessment;
- Interaction between the National EIA law and other environmental laws;
- World Bank guidelines for Environmental Assessment;
- European legislation of reference for environmental protection;
- Albanian policy for the Energy Sector;
- Plans related to soil, water and groundwater protection;
- Spatial and urban planning relevant to Project site.

3.2. GENERALITIES ON ALBANIAN INSTITUTIONAL AND LEGISLATIVE FRAMEWORK

The Ministry of Environment, Forest and Water Administration has been established in Albania since 2005.

Until 1991, the main relevant acts of the environmental legislative framework were the "Environmental Protection from Pollution", No. 5105, issued in 1973 and the Decision of the Council of Ministers, No. 205, issued in 1973, containing measures for environmental protection and pollution abatement.

After 1991, due to political changes and new needs deriving from the de-centralized economy, a process was started of drafting and amending a number of laws, mostly referred to EU countries models.

In the period 2002-2003 a significant package of laws concerning the environment has been approved by the Albanian Parliament. In particular, based on legislative acts, the Government is obliged to guarantee a healthy and ecologically sound environment, for present and future generations, and a rational use of natural resources including forests, waters and pastures, according to sustainable development requirements. Furthermore the right of information on environmental status and environmental protection is to be guaranteed.

3.3. ALBANIAN LAWS, DECISIONS AND INTERNATIONAL CONVENTIONS RELEVANT TO ENVIRONMENTAL PROTECTION

An overview of the Albanian legislative framework on environmental protection is reported in *Table 3.3a* and *Table 3.3b.* They refer to a wide range of environmental and environment-related issues the main of which are pollution reduction, water resources, air quality, contamination control and remediation, land use, waste, legalization of unplanned urban development processes, municipality administration, environmental monitoring activities, responsibilities and right of information.

Table 3.3a *Laws*

Number	Date	Title
Law No. 7501	19/07/1991	Land (with relevant amendments and modifications)
Law No. 7623	13/10/1992	Forests and Forest Service Police
Law No. 7665	21/01/1993	Development of Areas with Tourism Priorities
Law No. 7895	27/01/1995	The Penal Code of Albanian Republic (Chapter IV environmental crimes)
Law No. 7917	13/04/1995	Pastures and Meadows
Law No. 8094	21/03/1996	Public Removal of the Solid Waste
Law No. 8093	21/03/1996	Water Reserves
Law No. 8102	28/03/1996	Regulatory Framework of the Water Supply Sector and Removal and Treatment of Polluted Waters
Law No. 8302	12/03/1998	Administration of the Forests' and Pastures' Income – Public Property
Law No. 8405	17/09/1998	City Planning (with relevant amendments)
Law No. 8053	30/06/1999	Right to be Informed concerning Official Documents
Law No. 8652	31/07/2000	Local Authorities Organization and Functioning
Law No. 8897	16/05/2002	Protection from Air Pollution
Law No. 8905	06/06/2002	Protection of the Marine Environment from Pollution and Deterioration
Law No. 8906	06/06/2002	Protected Areas
Law No. 8934	05/09/2002	Protection of the Environment, is the basic law, running after the laws approved on 1993 for Environmental Protection
Law No. 8990	23/01/2003	Environmental Impact Assessment
Law No. 9010	13/02/2003	Environmental Administration of Solid Waste
Law No. 9108	17/07/2003	Chemical Substances
Law No. 9115	24/07/2003	Environmental Treatment of the Polluted Waters
Law No. 9244	17/06/2004	Protection of the agriculture land
Law No. 9298	28/10/2004	Ratification of Concession agreement of BOT type, for building and exploitation of oil and its product pipeline in the coastal area of Porto Romano
Law No. 9482	03/04/2006	Legalization, Urbanization and Integration of illegal buildings
Law No. 9537	18/05/2006	Administration of the hazardous wastes
Law No. 9587	20/07/2006	Protection of the biodiversity
Law No. 9693	19/03/2007	Pastures land
Law No. 9774	12/07/2007	Assessment and administration of the noise in the environment

Table 3.3b *Decision of the Council of Ministers and other norms*

Number	Date	Title
DCM [1] No. 228	27/05/1992	Protection of Urban Areas from Pollution and Deterioration
DCM No. 88	01/03/1993	Approval of Areas with Tourism Development Priorities
DCM No. 420	17/08/1993	General Approval of the Agreement for the Program of Integrated Administration of the Seaside Area in Albania
DCM No. 26	31/01/1994	Dangerous Waste and Residues
DCM No. 102	15/01/1996	General Approval of the Strategy for the Implementation of the Project on Environmental Evaluation by the Implementation of the Forests Project
Instruction	06/01/1998	Environment Information Providing. The Public Right to be informed
DCM No. 145	26/02/1998	Hygiene-sanitary regulation for analysis of drinking water quality, designing, building up and monitoring of drinking water supply systems
DCM No. 103	31/03/2002	Environment Monitoring in the Republic of Albania
DCM No. 364	18/07/2002	Approval of the Administration Plan for the Seaside Area
DCM No. 435	12/09/2002	Norms approval for air discharging in the Republic of Albania
DCM No. 676	20/12/2002	Proclamation as protected area of the Albanian nature monuments
DCM No. 249	24/4/2003	Approval of the documentation necessary for the environmental license and of the components of the environmental license
DCM No. 268	24/4/2003	Certification of specialists for the evaluation of the environmental impact and environmental auditing
DCM No. 266	24/4/2003	Protected areas administration
DCM No. 267	24/4/2003	Procedures for the proposal and proclamation of the protected and buffer zones
DCM No.803	04/12/2003	On the air quality norms
Regulation No. 1	17/08/2004	The participation of the public in the environmental impact assessment
DCM No. 560	27/08/2004	Determination of facilitating conditions for the construction of new plants for the production of the electric energy
DCM No. 177	31/03/2005	Allowed effluent discharges norms and the criteria for the zoning of the water media where the effluents will be discharged
Guidance of the Minister No 2	21/05/2007	The approval of the list of activities with environmental impacts, rules and procedures to issue the authorization and consent for the regional environmental agencies
DCM	02/07/2008	On public participation in the decision making process

The main regulation concerning the environmental protection is Law No. 8934 issued in September, 2002 which aims at defining the rational use of environmental resources and the reduction of environmental pollution. Main objectives of this law are also the Environmental Impact Assessment procedure and the environmental permits.

Some other legislative acts of *Table 1* relevant to the Project objectives are briefly described hereinafter:

(1) Decision of the Council of Ministers

Air Quality

- Law No. 8897 on Protection from Air Pollution issued in May, 2002 aims to guarantee air quality by imposing restraints on air emissions. According to the Law, air polluters are required to obtain environmental permits for air polluting activities jointly from the Ministry of the Environment and the local governments.
- Decision No. 435 concerning norms approval for air emissions in the Republic of Albania issued in September, 2002 establishes the allowed levels of pollutants in the air by sector of activity.
- Decision No. 803 on air quality norms issued in December, 2003 establishes the limit values for atmospheric pollutants.

Liquid effluents

- Law No. 9115 concerning the environmental treatment of polluted waters issued in July, 2003 requires entities which discharge polluted waters to continuously reduce the amount of polluted waters discharged, to cut the degree of pollution and to treat polluted waters.
- Decision No. 177 on allowed norms of liquid releases and the zoning criteria of receiving water environments issued in March, 2005 regulates the pollution of receiving water environments from dangerous substances (List I and II of Annex no. 1) by establishing the limit levels for a list of substances (Annexes 2 and 3) and the criteria for identification of sensitive and less sensitive zones to which different provisions shall apply (Annex 5).

Solid Waste

- Law No. 9010 on environmental treatment of solid waste issued in February, 2003 aims at ensuring the protection of the environment and human health from pollution and damages resulting from solid waste through environmental treatment at every stage from production to disposal. Waste producers are under the obligation to:
  - identify appropriate recycling and processing systems in accordance with the type of technology they employ and the nature and amount of waste they create;
  - collect and treat waste so as to ensure that subsequent processes of environmental waste management are properly handled;
  - separate waste at the origin and collect it separately;
  - establish a monitoring system and publish the monitoring data every 3 months.

  Waste producers must elaborate technical, technological and organizational waste plans which are subject to review by the Environmental Inspectorate, by the licensing authority and by the local government authorities. Processing and disposal of industrial waste is done in specially designed plants and technologies for each type of industrial waste.
- Law No. 9537 on hazardous waste management issued in May, 2006 establishes obligations upon the producer which shall:

- put in place a written programme to reduce the volume, quantity and toxicity of hazardous waste;
- be responsible for the costs of transport, disposal or recovery of the hazardous waste that it generates;
- transfer hazardous waste only accompanied by a consignment note and only to an authorised operator;
- avoid mixing hazardous waste with other waste;
- maintain records (quantity, nature, origin, mode of transport and treatment method) of all of the hazardous waste that it generates in a format to be specified from the Minister and forward a copy of those records to the Regional Environmental Agency in the relevant district every six month.

Noise

- Law on the assessment and management of environmental noise No. 9774 issued in July, 2007 requires juridical persons, whose activities, equipment and/or plants produce noise, to take preventive measures and to observe the noise limit values. For activities which produce noise, the environmental permit sets the requirements that they have to meet for complying with this law.

Furthermore the Parliament of Republic of Albania ratified a series of International Conventions and Protocols concerning environmental issues. The main acts related to environmental protection, informing and public participation are presented in *Table 3.3c*.

Table 3.3c Main Environmental Conventions ratified by the Republic of Albania

Name	Contents	Ratification Date
Basel Convention	Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal	May 13, 1997
Barcelona Convention	Convention for the Protection of the Mediterranean Sea against Pollution	October 26, 2000
Ramsar Convention	Convention on Wetlands of International Importance especially as Waterfowl Habitat	March 29, 1996
Åarhus Convention	Convention on the right of the public information, and participation on the environmental decision making process and to approach the court apropos environmental cases	October 26, 2000
Kyoto Protocol	Kyoto Protocol to the United Nations Framework Convention on Climate Change	April 1, 2005

3.4. ALBANIAN LAW ON ENVIRONMENTAL IMPACT ASSESSMENT

3.4.1. *Requirements for in-depth EIAs*

The current Law No. 8990 on *Environmental Impact Assessment* was approved on January 23, 2003.

This Law identifies the list of projects which should be submitted to Environmental Impact Assessment in two Annexes to the Law. Annex 1 identifies the projects which should undergo a *in depth EIA* whereas projects included in Annex 2 should be submitted to a *simplified EIA.*

The Thermal Power Plant Project for Porto Romano is classified as *Thermo-plants of production of energy and other burning plants with a production of heat higher than 50 MW* (Annex 1, point 2) and therefore shall undergo an *in depth* environmental impact assessment. Therefore this EIA is prepared in compliance with the requirements of the in depth EIA as defined above.

The contents of the *simplified EIA* are the following:

- Objective of the project;
- Detailed objective description;
- Data on present environment of the area and in its vicinity where the project is implemented;
- Detailed description of all installations that are part of the project or will be used during its implementation;
- Construction plan and the deadlines of its implementation;
- Description of engineered values that are constructed or enlarged and of necessary works for project implementation;
- Potential impacts on environment and proposed measures to prevent or bumper these impacts;
- Monitoring program of project's impact on environment;
- Conformity of the project with territory adjustment plan and with economic development plan of area where the project will be implemented;
- Summary of consultations with local government organs, the public and environmental non-for profit organizations;
- Rehabilitative measures in case of pollution and damage of environment as well as their cost;
- A copy of the license of natural or juridical person which has prepared the report of impact assessment on environment.

According to Law No. 8990 the supplementary contents of an EIA for projects of Annex 1 include:

- Procedures and reasons for selecting the site where the project will be implemented, description of at least two additional options of location of project;
- Its direct and indirect level of impact on environment;
- Potential impacts of project's options on environment and health;
- Risks of accidents with significant impact on health and environment and measures to prevent them;
- Trans-border impact on the environment if any;
- Technical measures/plans to prevent and bumper negative impacts on environment;
- Detailed descriptions about sustainable use of energy, of natural and mining resources;

- Potential negotiations'plans with local governmental bodies, the public and environmental non-for profit organizations during the phases of planning, review and implementation of the project.

3.4.2. *Environmental Impact Assessment Procedure*

The procedure for the Environmental Assessment in Albania has been summarized *in Paragraph 1.2*.

3.5. WORLD BANK ENVIRONMENTAL GUIDELINES FOR ENVIRONMENTAL ASSESSMENT

The World Bank guidelines on Environmental Assessment (EA) are defined in the Operational Procedure 04.01.

The Procedure establishes that depending on the project, a range of instruments can be used: environmental impact assessment (EIA), regional or sectoral EA, environmental audit, hazard or risk assessment, and environmental management plan (EMP).

The Porto Romano Project is classified as Category A that is to say a project likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works. EA for a Category A project examines the project's potential negative and positive environmental impacts, compares them with those of feasible alternatives (including the "without project" situation), and recommends any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and improve environmental performance. For a Category A project, the applicant is responsible for preparing a report, normally an EIA. The contents of the EIA for the Category A are defined as follows:

- *Executive summary*. Concisely discusses significant findings and recommended actions;
- *Policy, legal, and administrative framework*. Discusses the policy, legal, and administrative framework within which the EA is carried out. Explains the environmental requirements of any co-financiers. Identifies relevant international environmental agreements to which the country is a party. Describes the relationship between the proposed project and relevant territorial and sectoral plans and programmes;
- *Project description and analysis of alternatives*. Concisely describes the proposed project (and alternatives) and its geographic, ecological, social, and temporal context, including any offsite investments that may be required (e.g., dedicated pipelines, access roads, power plants, water supply, housing, and raw material and product storage facilities); shows incoming and outgoing material flows, selected process, technology, water intake and discharge, air pollutant abatement systems, effluent treatment, emergency plan in the case of any system malfunctioning, technical measures to reduce noise, water consumption. Indicates the need for any resettlement plan or indigenous people development plan. Includes a map showing the project site and the project's area of influence. Systematically compares feasible alternatives to the proposed project site,

technology, design, and operation, including the "without project" situation, in terms of their potential environmental impacts, the feasibility of mitigating these impacts, their capital and recurrent costs, their suitability under local conditions and their institutional, training, and monitoring requirements.

- *Baseline data*. Assesses the dimensions of the study area and describes relevant physical, biological, and socioeconomic conditions, including any changes anticipated before the project commences. Also takes into account current and proposed development activities within the project area but not directly connected to the project. Data should be relevant to decisions about project location, design, operation, or mitigation measures. The section indicates the accuracy, reliability, and sources of the data.
- *Environmental impacts*. Predicts and assesses the project's (and alternatives) likely positive and negative impacts, in quantitative terms to the extent possible. States the basis for selecting the particular project design proposed and justifies recommended emission levels and approaches to pollution prevention and abatement. Identifies mitigation measures and any residual negative impacts that cannot be mitigated. Explores opportunities for environmental enhancement. Identifies and estimates the extent and quality of available data, key data gaps, and uncertainties associated with predictions, and specifies topics that do not require further attention.
- *Environmental Management Plan (EMP)*. Covers mitigation measures, monitoring, and institutional strengthening.

3.6. EUROPEAN LEGISLATION OF REFERENCE FOR ENVIRONMENTAL PROTECTION

The EIA process will also take into account the European quality standards, by relevant topic, contained in the following European Directives:

- Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe;
- Directive 2004/107/EC of the European Parliament and of the Council of 15 December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air;
- Council Directive 1999/30/EC of 22 April 1999 relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air;
- Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise;
- Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy and Proposal for a Directive of the European Parliament and of the Council on environmental quality standards in the field of water policy and amending Directive 2000/60/EC [COM(2006) 398];
- Directive 2006/12/EC of the European Parliament and of the Council of 5 April 2006 on waste and Proposal for a Directive of the European Parliament and of the Council of 21 December 2005 on waste [COM(2005) 667].

3.7. ALBANIAN POLICY FOR THE ENERGY SECTOR

During the 90's, Albania signed the Energy Charter Treaty (1994) and the Protocol of the Energy Charter Treaty for Energy Efficiency and the Environmental Aspects (1995) which both serve as legal basis for Albanian international co-operation in the energy field and for the elaboration of a national energy strategy.

Albanian energy policy is described in a document adopted by the National Government in June 2003, the "Albanian National Strategy of Energy". The specific objectives of the National Energy Strategy are to:

- Increase of the security and reliability of the energy supply in general and electricity in particular, at national and regional level;
- Establish an efficient energy sector from the financial and technical aspects;
- Establish an effective institutional and regulatory framework and restructuring of energy companies;
- Increase the energy efficiency in generation/production and final use of energy sources aiming a minimal environmental pollution;
- Optimize the supply system with energy sources based on the least cost planning principle with minimal environmental pollution;
- Considerably increase investments in the energy sector through capital enhancement by International Financial Institutions as well as private capital;
- Establish a competitive electricity market according to EU requirements for the electricity sector reforms (Directive 96/92/EC) and Albania obligations under the Athens Memorandum (November 15, 2002) to support the energy sector integration into the Southeast Europe Regional Electricity Market and the interconnection with Union for the Co-ordination of Transmission of Electricity (UCTE) network.

3.8. PLANS RELATED TO SOIL, WATER AND GROUNDWATER PROTECTION

The following paragraphs provide some indications on legal requirements and activity plans that apply to the coastal area in general and to Porto Romano area in particular.

The Law on Waters No. 8093 of the 21.3.1996, determines that the water authority shall be involved in the authorization process regarding projects to be developed in the stripe of land contained between the shore and a boundary that varies between 100 and 200 m from the shore line.

The Porto Romano area is included in the Integrated Coastal Zone Management and Clean-Up Project, financed by the World Bank and managed by the Albanian Ministry of Environment, Forests and Water Administration. The project aims to protect the coastal natural resources and cultural assets, and promote sustainable development and management of the Albanian coast. Mitigation of soil and groundwater contamination in the chemical plant at Porto Romano by remediation and clean-up works are part of the project's main actions.

3.9. SPATIAL AND URBAN PLANNING RELEVANT TO THE PROJECT SITE

The following paragraphs provide a summary of the urban planning situation on the Project site.

The legal framework for urban planning in Albania is defined by the Law Nr.8405, of the 17.9.1998.

According to this law the highest state organ for approval of the urban planning studies is the Council of Territory Adjustment of the Republic of Albania (CTARA). CTARA is a decision organ and functions close to the Council of Ministers. The Chairman of the CTARA is the Prime Minister.

The management of land for construction shall be done through regional plans, master plans, general adjustment plans, and partial urban planning studies. Regional plans and master plans shall be prepared for periods of over 20 years, whilst general adjustment plans and partial urban planning studies shall be prepared for certain periods of 10 to 15 years including priorities of the 5 year first phase. These plans have not yet been approved for the project area.

According to a Decision of 1999, the Porto Romano Project site area falls under the spatial and urban planning competence of the city of Durrës (see *Figure 3.9a Administrative Boundaries*).

Decision No. 703 issued in April 2008 approves the study on "Integrated Development of the Energy and Industrial area of Porto – Romano, Durrës " (*Figure 3.9b*). The same decision establishes that the CTARA shall elaborate the Master Plan for the Porto Romano area and its connection (road network, railroad and connection to the electric national grid) within three months from its entry into force. Furthermore, Decision No. 703 requires the Ministry of Economy, Trade and Energy to elaborate, within three months from its entry into force, a legal act on the conditions and procedures to obtain the relevant building and operation licence in the Porto Romano area.

4

4. THE PROJECT

4.1. SITE LOCATION

The proposed Power Plant will be located in the North-West of Albania, on the East coast of the Adriatic Sea.

The proposed site is a flat green-field land, located about 10 km North of Durrës , 25 km Nord-West of Tirana.

The area is rural but close to several industrial plants (i.e. oil and gas storages connected to a pier to receive materials).

The mean elevation of the site is about the same as marine level. The site covers an area of about 80 hectares.

The connection to the site will happen through the existing roads, accordingly widened, connecting the area to Durrës – Tirana highway. Some new roads are foreseen close to the site.

Figure 1.3a shows the site location.

The Power Plant will be connected to the existing national power grid in *Tirana 2 Substation* by means of a 25 km long 400 kV power line.

The Power Plant will burn coal, which will be delivered to the site through boats and using a new 950 m long pier, to be built adjacent to the site fence.

4.2. ALTERNATIVES

4.2.1. *Site Locations*

Enel evaluated the location of the project by means of a preliminary screening analysis of different sites in Albania.

The final analysis compared the following potential locations:

- Porto Romano;
- Shengjin;
- Vlore.

Porto Romano site is rural, adjacent to industrial activities. A plan for the industrial development in the Porto Romano area is being developed by the Ministry of Economy, Trade and Energy. The Project is in line with a zoning plan, which is still under discussion, according to which the Porto Romano site falls in the zone dedicated to the development of an Energy Park.

For the Vlore_site is foreseen an industrial use, but the possibility of a new energy park is excluded.

This site is also only 1 km from Vlore city.

Moreover at present a new thermal power plant (98 MW) is under construction in Vlore.

For Shengjin site is foreseen a touristic development and the increase of light industry.

Moreover, Vlore and Shengjin sites are close to protected areas.

For these main reasons Enel decided to develop the project in Porto Romano site.

4.2.2. *Fuel*

Possible fuels for the planned size of Power Plant are traditionally coal, oil and natural gas.

Enel's choice to propose a coal fired Power Plant depends on the following main factors that almost force the decision:

- Coal is available in large quantity on the international market and its availability is only in a minimal part influenced by geopolitical factors, because there are several producing countries in the world. Its price makes the investment sustainable; as described in *Chapter 2*, from an ecological point of view, the adoption of the most modern emission capture technologies and the greater efficiency of the plants make the use of coal compatible with the actual strictest environmental regulations;
- Oil is available in large quantity on the international market, but its availability and its price are deeply influenced by geopolitical and financial factors because the producers in the world are limited. Its price at the moment is very high and the investment might be not sustainable;
- Natural gas is not available in Albania and the need for a long pipeline is a non sustainable investment. Moreover, the potential impact of such pipeline would be very high.

4.3. COAL FIRED POWER PLANT

The Porto Romano Thermal Power Plant is based on two ultra-supercritical coal fired units, each sized for 800 MWe gross power production (at reference conditions).

The project has been designed according to Best Available Techniques applicable to this kind of Large Combustion Plant.

Staged combustion will be adopted to control NOx in-furnace concentration.

The flue gas treatment system includes for each unit the following: high dust Selective Catalytic Reduction (SCR) system to reduce NOx, fabric filter for dust removal, gas cooling unit and desulphurization plant (limestone-gypsum absorber).

Flue gases will be discharged into the atmosphere through a 150 m high stack for each unit.

The cooling system will use sea water, circulating in open cycle.

The plant will be ready for a future installation of a Post Combustion Carbon Capture and Segregation System.

The plant is designed in order to reduce raw water intake for industrial uses and related discharge, through a partial water reutilization cascade.

Industrial Water will be provided by sea water desalination and demineralization.

Waste water streams will be collected, sent to waste water treatment plants, and finally discharged to the sea, in compliance with relevant regulatory requirements.

The two units, each of 800 MWe, will be built in two phases.

Each unit of the plant will have the following main equipments:

- Steam boiler;
- Steam turbine;
- Condenser;
- Auxiliary boiler;
- Generator;
- Main Transformer;
- Selective Catalytic Reduction (SCR) system;
- Fabric filter;
- Gas cooler;
- FGD system;
- Stack.

The coal will arrive with oceanic boats, that will anchor 2-3 miles offshore. The coal will be transshipped to barges and then unloaded on the coast by means of a 950 m long pier.

The coal will be stored in a coal yard with two storage areas, one for each power unit.

The layout of the Plant is presented in *Annex 1*.

4.3.1. *Main Process Description*

4.3.1.1. *Combustion and Thermal Cycle*

Steam Boiler

The Steam Boiler will be ultrasupercritical once-through type, with single re-heat and will be operated in sliding pressure mode. It will be tower type. The steam conditions at boiler outlet will be: 605/620 °C (SH/RH) and 280/52 bara (SH/RH). Feedwater temperature will be 312 °C. Boiler efficiency will be approximately 95.2% with reference coal, at reference ambient conditions.

Minimum Technical Rate will be about 30% of nominal load. Light fuel oil will be used for boilers ignition, while heavy fuel oil could be used for start up (up to MTR - Minimum Technical Rate), in substitution of light fuel oil. A dedicated discharge system, storage and pumping station will be provided for both light oil and heavy fuel oil.

Staged combustion will be adopted to control NO_x in-furnace concentration below 400 mg/Nm^3 and a high dust Selective Catalytic Reduction (SCR) system will reduce NO_x below the guaranteed limit.

The boiler will be equipped with steam or water sootblowers. The bottom ashes extraction system will be a dry type. Heavy ashes will be crushed and either recirculated to the furnace, or stored into one proper daily silo, located next to the boiler, together with fly ashes.

The boiler bunkers capacity will be approximately 4,000 t, in order to guarantee 16 hours of autonomy.

Steam Turbine and Building

The Steam Turbine will be installed inside the machine hall; it will be single RH (Re Heated) and condensing type. It will be of modern design with high efficiency and reliability.

The steam turbine will have a tandem compound arrangement, having on a single axis a HP section, an IP section and two LP sections, with downward exhaust.

The steam turbine will have nine not-regulated steam extractions to condenser, to feedwater preheaters and to steam driven feedwater pump.

The steam turbine buildings of the two units will be connected through structural joints and internally communicating. Each building will have one crane bridge.

Condenser

Circulating water pipes will feed two sea water cooled aluminium brass condensers (one for each unit), each made of two separate bodies. Each body, in single pass configuration, will receive the steam coming from one LP steam turbine section.

Cooling water circuit siphon will be activated with dedicated pumps.

Provisions for a potential future condenser cleaning system, "Taprogge" type or equivalent, have been foreseen.

At ambient reference conditions (sea water average temperature of 18 °C), a condensing pressure of about 50 mbar can be achieved.

Thermal Cycle

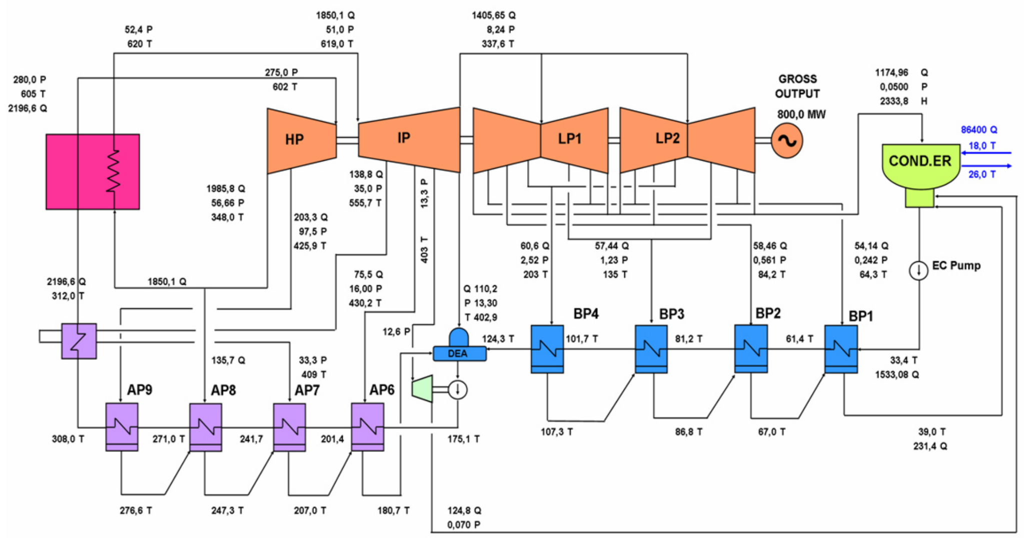
The steam, coming from the ultrasupercritical boiler, at about 605 °C and 280 bar, will be sent to the high pressure Heat Recovery Steam Generator (HRSG) of the steam turbine. As already described, the steam turbine will be single RH (Re Heated) and condensing type.

The re heated steam will get in the medium pressure HRSG at a temperature of about 620 °C.

At the end of its expansion, the low pressure steam will be sent to the sea water cooling system. The water system will be open cycle and the circuit water will be heated about 8 °C.

The following *Figure* shows the power plant thermal cycle.

Figure 4.3.1.1a   Power Plant Thermal Cycle



4.3.1.2. *Flue Gas Treatment Line*

A single flue gas treatment line has been foreseen for each unit: one air preheater, one dust removal unit (fabric filter), one induced axial fan, one Flue Gas Desulfurization (FGD) absorber. Upstream the FGD absorber, a gas cooling unit will be installed. All the above mentioned components will be installed on the same line, in order to reduce pressure losses.

The temperatures along the flue gas treatment line will be:

- T downstream the preheater: 122 °C;
- T downstream the fabric filter: 117 °C;
- T downstream the induced fan: 130°C;
- T upstream the FGD absorber: 105 °C;
- T downstream the FGD absorber: 48°C;
- T at the stack: 48 °C.

Flue gases, in saturated conditions ("wet stack" configuration), will be discharged into the atmosphere through a 150 m high stack for each unit.

Flue Gas Cooler

To facilitate the sulphur oxides reduction in the FGD absorber, flue gases will be cooled in a Flue Gas Cooler.

It consists of a shell and tube gas cooler, which will decrease flue gas temperature from about 130 °C to about 105 °C, and of an air heater downstream the secondary air fan, increasing secondary combustion air temperature from about 20 °C to about 60 °C. The flue gas side heat exchanger is an U and modular type. Demi water is the heat transfer medium.

Due to an aggressive condensed acid working atmosphere, fluoroplastic materials (or equivalent) will be used for gas cooler tubes.

The air side heat exchanger will be carbon steel made.

Fabric Filter

The Power Plant will be equipped with two fabric filters (one for each unit) for dust removal. Fabric filters will treat up to 2,4 MNm^3/h (wet), while firing a high ash coal (ash content 14.66 %/weight).

The filters will be pulse-jet type and will be arranged in independent bag compartments, each one equipped with man doors and insulation dampers, in order to allow maintenance activities also during operation.

A by-pass system, with the relevant poppet type no-leakage by-pass dampers, with sealing air and with a pre-coating system, will be provided in order to allow a safe start up.

The bag cleaning system will be on-line compressed air type; the compressed air for bag cleaning will be provided by dedicated compressors.

FGD System

Each unit will be equipped with one wet FGD (Flue Gas Desulfurization) limestone-gypsum absorber, which will assure SO_2 and dust removal in compliance with the emission limits reported in *Paragraph 4.6.1*.

Chemical additives (Adipic Acid or Dicarboxylic Acid Mixtures) dosing is foreseen in order to comply with the emission limit values in case of peaks in SO_2 inlet content and one pump out of service. The use of additives is not foreseen to achieve design performances at design conditions. FGD will operate slightly above atmospheric pressure.

To comply with dust emission limits, each FGD will be equipped with three stages of mist removal.

Each FGD will use a 30% w/w fine grinded limestone slurry, produced by lump milling, distributed by a ring loop, and will produce commercial grade gypsum.

Drift characteristics will comply with the following prescriptions:

- Drift < about 20 mg/Nm^3;
- 96% drift < about 20 micron.

A FGD auxiliary building will be located close to each absorber for the process pumps and the gypsum dewatering system.

A common temporary 3,500 m^3 tank will be installed for slurry recovery during long term absorber sumps outages.

Industrial water will be used for FGD make up and for gypsum and mist removal washing; in order to reduce net make-up water flow rate, the absorbers will receive also washing water streams from gas coolers.

Stack

The stack will be made of Glass Fiber Reinforced Polymer (GFRP), supported either by a steel structure or by a reinforced concrete structure; another alternative, currently under development, is a reinforced concrete stack with acid resistant lining.

Specific provisions will be adopted in order to prevent droplet falling, especially during start-up operations (i.e. droplet collectors on the top and at the bottom of the stack).

The stack diameter will be 7,5 m and the flue gases velocity will be about 18 m/s.

Stack height will be 150 m.

4.3.2. *Ancillary Systems*

4.3.2.1. *Coal Handling and Storage*

A transhipment system will be adopted in order to transfer coal to the Power Plant from the oceanic vessels.

Coal will be transferred from oceanic-vessels to dedicated barges, about 2-3 miles off-shore. The barges will have no more than 7 m draught and will be provided with a self-unloading system of about 1,200 t/h capacity.

From the barges the coal will be transferred in two hoppers installed on the pier head (contemporary self-unloading of the two barges is foreseen) and then on a 2,500 t/h covered conveyor belt, connecting the pier head with the boiler feeding system and with the coal storage yard.

Coal will be stored in two open-air piles, each one about 450 x 60 m, with a capacity of about 220,000 t.

Two portal type reclaimer machines and one boom type stacker machine will be installed. The stacker machine will be installed between the two coal piles, while the two reclaimer machines will be installed on the external side of both piles.

As shown in *Annex 1*, on three sides of the coal stockyard, 6 m high embankments are foreseen, occupying part of the ground already used for the stockyard area preload.

The machines will have a capacity of about 2,500 t/h for storage operations and 1.000 t/h for reclaiming operations. The conveyor belt system feeding the boiler will have a capacity of 2x1,000 t/h.

4.3.2.2. *Water Supply and Treatment*

Circulating Water System

The water intake will be located on the power plant Pier head, 950 m off-shore.

It will be made of steel, with 8 inlet openings, 4.00x2.50 m each, located 6.00 m below the average sea level. The cooling water will flow from the intake to the pumping basin, located near the plant fence, through four Glass Reinforced Plastic (GRP) underground pipes (two for each unit, ø=2,800 mm).

The water will be relaunched by two concrete basins, one for each unit. Each basin will contain two circulating pumps and will be equipped with removable steel panels for water basin inspection and maintenance.

The return circuit, after the condenser outlet, will be made of two underground concrete channels (3.00x2.50 m) for each unit, down to the final discharge, located on the shore line, adjacent to the Pier (as shown in *Annex 1*).

Sea Water Desalination Plant

The Desalination Plant for industrial water production includes the following:

- Pre-treatment with flotation, UV (Ultra Violet) sanitization, ultra/micro-filtration with related auxiliaries and water relaunching station;
- Flotation sludge relauching station to thickener and dewatering by filterpress;
- First stage sea water reverse osmosis.

The industrial water will be stored into 2 x 3,000 m^3 tanks equipped with pumping stations for feeding:

- the industrial water network;
- the fire water network;
- the demineralization plant.

Demineralization Plant

The demineralization plant, whose net production capacity will be about 120 t/h, will have a two stage brackish water reverse osmosis followed by 3x50% ion exchange mixed beds with backwashing and regeneration stations.

The plant will also be equipped with sulphuric acid and caustic soda (regenerants) unloading, storage and dosing stations.

Exausted regeneration streams will be collected into a pit and neutralized either by acid or caustic, before being sent to the effluent treatment plant tanks.

Demi water will be stored into 2 x 2,000 m^3 tanks, equipped with a pumping station to feed demi water network. The project foresees to use demi water as make-up not only for the water steam cycle, but also for the closed cooling circuit and for of the gas cooler - water side.

Steam Condensate Treatment Plant

The steam condensate treatment plant for each Unit will include:

- 100% prefiltration unit with backwashing;
- 100% mixed bed with spare resin charge and regeneration system.

The plant will also be equipped with sulphuric acid and caustic soda (regenerants) unloading, storage and dosing stations.

Exausted regenerations streams will be collected into a pit and neutralized either by acid or caustic before being sent to the effluent treatment plant tanks.

Waste Water Treatment Plant

The Waste Water Treatment Plant will include the following:

- Storm water "first flush" collection basins;
- Local oil separators;
- Effluent treatment plant;
- Sewage treatment plant.

Storm Water "First Flush" Collection Basins

Two storm water basins are foreseen: one for "first flush" water collection from power islands areas, the other for water collection from potential oil polluted areas. Clean storm water will be collected and released as such to the sea.

The pumped effluent from these basins will be sent to the effluent treatment plant tanks.

Oil Separators

Local oil separator basins will be installed in the transformers areas and in the machine hall buildings, to remove oil from runoff streams. Periodically, oil collected on the basins' surface will be removed.

The pumped effluent from such basins will be sent to the effluent treatment plant tanks.

Effluent Treatment Plant

Chemical waste water streams are:

- FGD blowdown;
- Industrial and demi water drainages;
- Ljungström washing water;
- Chemical samples;
- Demi and condensate treatment plant resins regenerations water.

The chemical waste water streams, together with the above mentioned effluents, will be collected into 2x2,000 m^3 process waste water tanks and will then be sent to the treatment plant.

This plant, whose treatment capacity will be 150 t/h, will have three basins for milk of lime addition, sulphide and polyelectrolite and/or ferric chloride dosing respectively. A clarifier will separate water and sludges. The latter will be sent to a thickening and dewatering system and finally to proper disposal. The water, instead, will be sent to a second clarification stage, at pH neutral with iron chloride and sodium hydroxide, and then to 3x50% sand filters, neutralization and final control basins.

The process waste water treatment plant will be equipped with unloading, storage, preparation and dosing stations for each added chemical.

Sewage Treatment Plant

The Sewage Treatment Plant will collect all the civil exhausted water streams from canteen, showers, toilet, etc.

The design capacity is equal to 75 m^3/day.

The plant will include the following:

- Rotating screening;
- Grit separation;
- Tank Buffering;
- Denitrification;
- Aeration;
- Clarification and sludge recirculation;
- UV disinfection;
- Final control and relaunching to the final waste water basin;
- Sludge holding tank with a relaunching station to the process waste water filterpress for a joint dewatering.

The treated sewage stream will comply with relevant regulatory requirements.

Waste Water Discharge

All the above mentioned treated streams will be collected together in a mixing basin, where an automatic monitoring system will verify the compliance to guaranteed liquid discharge limits, before discharging to the sea.

4.3.2.3. *Ashes Storage and Handling System*

The bottom ashes extraction system will be a dry type. Bottom ashes will be crushed and either recirculated to the furnace or stored into one proper daily silo, located next to the boiler, together with fly ashes.

Four ash storage silos, each one with a storage capacity of 6,000 t, are foreseen. Ashes could be removed by trucks or transferred by conveyor belt to the pier head, to be loaded on ships.

Storage silos will be provided with an ash wetting system, in order to reduce the potential dust production. Wetting water (20% of overhall ash quantity) will be taken from selected low salinity waste streams and from the industrial water network.

Ashes and gypsum will be transported to the pier head on the same covered conveyor belt, sized for about 600 t/h.

4.3.2.4. *Limestone and Gypsum*

Limestone Storage and Milling

Limestone handling will have an automatic control equipment.

Limestone will be precrushed by three hammer mills, each one sized for 12,5 t/h capacity, and stored in double extraction hopper before being sent to three wet ball mills, each one sized for 12,5 t/h capacity.

The crushing and milling system will be installed in a dedicated building, next to limestone storage.

Limestone slurry will be collected into two 150 m^3 tanks and recirculated by 2X100% rings to feed absorbers.

A 1 x 300 t/h conveyor belt will bring the limestone to the crushing and milling house.

Gypsum Treatment, Storage and Handling System

The Gypsum produced by the FGD system will be treated in a dewatering system based on 2+2 x 100% trains (1+1 for each FGD) consisting of hydrocylone and vacuum belt filter system, each one sized for 25 t/h capacity, in order to obtain gypsum with an humidity content lower than 10%.

Gypsum will be washed in order to reduce the chloride content below 100 ppm. Referring to limestone design composition, gypsum purity has been foreseen ≥ 95%.

Filtered water will be collected in two dedicated tanks, together with vacuum pumps liquid ring blowdowns, and reused for limestone milling.

The quality of the produced gypsum will make it usable for gypsum wallboard or cement production.

Gypsum will be stored in a dedicated 10,000 t building, in the area shown in *Annex 1*.

The gypsum handling system will have an automatic control equipment.

From the storage building, gypsum will be loaded on a conveyor belt for transportation to the pier head. The pier head will be equipped with a loading belt machine.

As above described, ashes and gypsum will be transported to the pier head on the same conveyor belt, sized for about 600 t/h, and used in alternate periods (washing may be requested, when shifting products).

It will be also possible to handle gypsum from the storage building by trucks.

The gypsum humidity content will not allow dust emission during handling.

4.3.2.5. *Urea Storage and Ammonia Production System*

Ammonia for NO_x SCR system will be produced through a high temperature-pressure hydrolysis of urea water solution. Urea preferentially will be supplied as a solid and transported in containers, sent to 2 x 100% dissolver tanks and stored in a 150 m^3 tank. 2 x 100 % hydrolizers will produce gaseous ammonia for the SCR.

4.3.2.6. *Auxiliary Boiler*

An auxiliary boiler will be used for steam production during Power Plant start-up.

4.3.2.7. *Carbon Post Combustion Capture Plant*

It is possible to capture the carbon dioxide produced in coal combustion and confine it back into the deepest layers of the earth.

Research centres and industrial operators all over the world are working at identifying the best system to do this. In particular there are many research projects in progress in the United States and in the European Union.

After the CO_2 has been captured it can be confined in geological formations, such as the already exploited deposits of oil and gas and the deep saline aquifer folds.

Enel is committed in experimental projects aimed at the industrial demonstration of the technology for capturing CO_2 released from conventional fossil fuel power plants and holding it geologically.

This technology is at the moment not applicable on industrial scale.

Nevertheless, in the Porto Romano Thermal Power Plant a suitable area will be dedicated to a potential future installation of a Carbon Dioxide Capture Plant, once this technology will be ready for industrial scale applications.

4.3.2.8. *Electrical Systems*

The Generator of each Power Plant unit will be connected to the HV grid with a 3 x 297 MVA single phase step-up transformers.

The Power Plant electrical system will include a MV circuit breaker.

The auxiliary electrical system will be 10 kV (n. 2 bus-bars: AU1, AU2), double radial type, connected with 2 three phases winding auxiliary transformers TU1, with consumers equally distributed on two MV unit switchgears.

Adjacent to the Power Plant fence are also foreseen:

- a Power Station for the 400 kV power line connecting the Power Plant to Tirana 2 National Grid Power Station;
- a Power Station for the 500 kV DC undersea cable to Italy.

The analysis of the Power Stations, the Power Line to Tirana 2 Station and the undersea cable to Italy is presented in separate Environmental Impact Assessment Studies.

4.3.3. *Complementary Facilities*

As described in *Chapter 1*, the proposed Thermal Power Plant is part of the Project called "Energy Complex" including:

- the Thermal Power Plant;

- a Pier, 950 m long, which is used to receive coal and to ship the byproducts from the plant (gypsum, ash);
- a 400 kV power line, about 25 km long, which connects a new power station to Tirana 2 National Grid Power Station;
- a 500 kV DC undersea cable, about 210 km long, which connects a new AC/DC conversion power station to Italy.

The Power Plant, the Pier, the Power Line, the Undersea Cable and annexed facilities have been analyzed in four separate Environmental Impact Assessment Studies.

Annexed Facilities of the Thermal Power Plant are:

- conveyor belts for coal, gypsum and ash installed on the Pier;
- water intake and discharge facilities;
- roads.

Conveyor belts and water intake/discharge facilities are described in the above *Paragraphs*.

As shown in *Figure 4.3.3a* the Thermal Power Plant project foresees new 6 meters wide roads in the area close to the plant fence and the widening of some existing roads. Also the road connecting the Power Plant to Durrës will be modified accordingly.

These roads will be used for trucks transportation during construction and operation phase.

Figure 4.3.3a *Roads to be Enlarged and New Roads*

4.4. TECHNICAL PERFORMANCES AND MASS BALANCE

4.4.1. *Technical Performances*

The technical performances of each unit at reference ambient conditions are reported in the following Table 4.4.1a.

Table 4.4.1a Technical Performances of the Plant (Each Unit)

Parameter	M.U.	One Unit	Two Units
Thermal power	MW_{th}	1,697	3,394
Boiler efficiency	%	95.2	95.2
Gross power output	MW_{e}	800	1,600
Gross efficiency	%	47.1	47.1
Auxiliaries consumption	MW_{e}	41	82
Net power output	MW_{e}	759	1,518
Net efficiency	%	44.7	44.7

4.4.2. *Mass Balance*

The estimated Mass Balance of each unit at reference ambient conditions is reported in the following *Table 4.4.2a*.

Table 4.4.2a Estimated Mass Balance of the Plant (Each Unit)

Parameter	M.U.	One Unit	Two Units
Coal consumption	t/h	243.0	486.0
Limestone consumption	t/h	4.7	9.4
Gypsum production	t/h	8.0	16.0
Bottom ashes production	t/h	2.8	5.6
Fly ashes production	t/h	25.1	50.2

4.5. USE OF RESOURCES

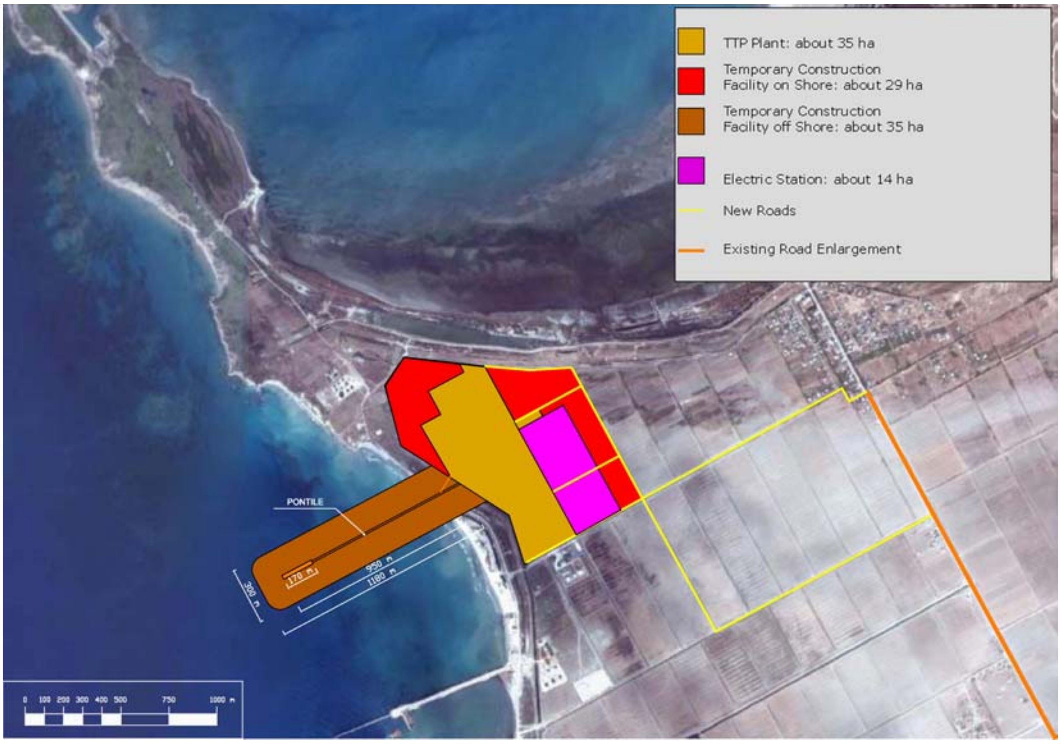
4.5.1. *Site Land Use and Buildings*

The total area occupied by the project will be about 80 hectares, while the area directly covered by the power plant will be about 62 hectares (Power Plant and Power stations). The remaining area will be maintained green or not waterproof.

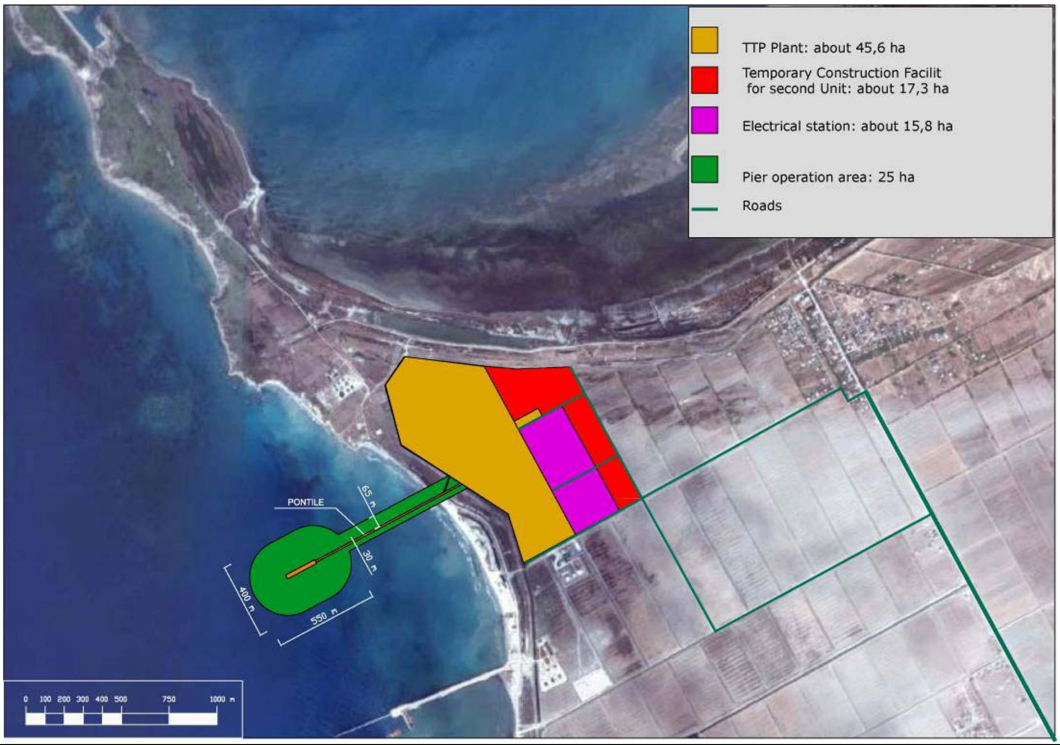
Figure 4.5.1a shows the areas occupied by the plant in first and second construction phase.

Figure 4.5.1a *Occupied Areas*

First Phase



Second Phase



The following *Table 4.5.1a* shows the dimensions of the main Power Plant building/facilities. Items numbers and construction time-schedule of all building/facilities are reported in *Annex 1*.

Table 4.5.1a Dimension of the Main Power Plant Building/Facilities

Item	Description	Length 1 (m)	Length L2 (m)	H (m)
3	guard / gatehouse, infirmary and weigthbridge	27	27	4,5
4	Canteen	31	40	4,5
5	changing room and infirmary	27	21	4,5
6	administration building	20	60	4,5
7	Workshop	80	20	7,5
8	Warehouse	80	26	7,5
9	ultrasupercritical boiler	55	63	110-55
10	coal bunkers	45	14	70
11	fabric filter	42	30	35
12	induced fan	15	30	12
13	gas-cooler	19	16	25
14	flue gas desulphurization (FGD) unit	23	0	45
15	auxiliary FGD building	22	39	12
16	FGD slurry recovery storage tank	9	0	10
17	flue gas duct	8	41	~ 42
18	flue gas stack	8	0	150
19	main machine hall building	91	40	38
20	main transformers	8	12	8
21	auxiliary transformers	6	8	8
22	auxiliary services building	22	32	16
24	cooling water pumps basin and building	20	16	8
26	fire fighting building (sea water pumps)	30	30	7,5
27	light oil and heavy fuel oil tanks	17 (diameter)	-	10
28	air compressors building	10	21	12
29	auxiliary boiler	10	15	15
30	CO_2 storage building and H_2 bunker	9	13	3,5
31	coal yard	450	60	23 (on the top)
33	coal towers (t1)	30	15	35
33	coal towers (t2)	16	16	25
33	coal towers (t3)	15	14	70
35	ashes silos (each)	20 (diameter)	-	32
36	urea to ammonia plant and building	14	27	4
37	limestone storage area	28	60	11
38	limestone crushing and milling house	29	21	18
39	limestone slurry tank	10 (diameter)	-	~ 10 m
40	gypsum dewatering building	30	23	18
41	gypsum storage building	30	90	25
44	biological waste water treatment plant	13	8	6
45	raw water basin	18	8	12
46	industrial water treatment system	11 (diameter)	-	6
48	industrial water tanks	20 (diameter)	-	10
49	demineralization plant	40	60	7,5
50	demineralized water storage tanks	6	32	10
51	waste water storage tanks	16 (diameter)	-	12
53	waste water treatment plant	18 (diameter)	-	2,5

Item	Description	Length 1 (m)	Length L2 (m)	H (m)
54	water treatment auxiliaries building	21	20	~ 8
57	chemicals storage	9	18	3
58	heavy equipment warehouse	42	19	7,5
59	lubrificant oil storage	17	11	4
60	daily ashes silo	10 (diameter)	-	~ 10

4.5.2. *Water Supply*

Sea water will be supplied to the Power Plant through a pipe located on the side of the pier with the intake on top of the pier.

Sea water will be collected and treated in the desalination and demineralization plant (Reverse Osmosis Plant), that will provide water for sanitary services and make up for industrial use.

Water consumption will be about 1,140 t/h for two units operation (about 646 t/h for one unit operation).

The cooling system will also use about 26,5 m^3/s of sea water for each unit, circulating in open cycle.

Annexes 2-3 show the water balance of the Power Plant in both configurations (one unit, two units).

4.5.3. *Fuels*

The Power Plant is designed in order to be fed with imported coal with a sulphur content up to 1,5% w/w.

Coal will be used for steam boiler and auxiliary boiler.

Light oil will be used for boilers ignition, while heavy fuel oil will be used for start up (up to MTR- Minimum Technical Rate).

Coal consumption will be about 240 t/h for each unit at reference condition.

Considering about 8,000 hours per year of operating time, the total quantity of coal used every year by the *Power Plant* will be about 3,850,000 t (consumption for two units).

South-African coal has been considered as reference fuel. The technical performance calculations are based on such fuel.

Table 4.5.3a Reference Fuel

Parameter	U.M.	Value
LHV	kcal/kg	6,000
Humidity	% w	9.30
Ash	% w	11.10
Carbon	% w	65.73
Hydrogen	% w	4.08
Nitrogen	% w	1.64
Sulphur	% w	0.66
Oxigen	% w	7.49

An hypothetic coal having 1.5% S content has been considered for FGD design and gypsum/limestone sizing purpose.

A high ash coal (ash content 14.66 %/weight) has been used for fabric filter sizing purpose.

4.5.4. *Raw Materials*

Main raw materials will be limestone and urea.

Limestone will be used in the desulphurization plant (limestone-gypsum absorber). Its consumption will be about 4,7 t/h for each unit. Considering 8,000 hours per year of operating time, the total quantity of limestone used every year by the plant will be 75,000 t (consumption for two units).

Limestone design quality is shown in the following *Table*.

4.5.4a Limestone Design Quality

Limestone	U.M.	Design value	Min requirement
$CaCO_3$	%	97,74	> 92,00
MgO	%	0,34	< 3,00
SiO_2	%	0,90	< 3,00
Fe_2O_3	%	0,09	< 1,00
Al_2O_3	%	0,36	< 1,50
Moisture	%	3	< 5,00
Size	mm	10 ÷ 50	< 8% below 10 mm

Urea will be used in the Selective Catalytic Reduction (SCR) system for the reduction of NOx in flue gas. Its consumption will be about 4,500 t/year for two units.

4.5.5. *Personnel*

During operation the *Power Plant* will employ approximately 140 people for the first unit. This number will increase up to 220 workers when the second unit will be in operation.

Additional workforce will be employed by contactors that will be constantly operating on site to perform services such as canteen, cleaning, greenery, security.

4.6. ENVIRONMENTAL INTERFERENCES

4.6.1. *Air Emissions*

Steam Boiler flue gas represents the main source of air pollutants emission; the auxiliary boiler has to be considered as an occasional emission source.

Flue gases will be discharged into the atmosphere through a 150 m high stack for each unit.

The staged combustion and the flue gas treatment system will guarantee the emission limits presented in the following *Table 4.6.1a*.

As shown in the Table, the guaranteed emissions limits will be lower than the corresponding EU emission limits (*Directive 2001/80/CE*) for this type of Power Plant.

Table 4.6.1a Emission at the Stack – Nominal Power Rate – Natural Gas

Pollutant	Concentration* [mg/Nm³]	Total Mass Flow for each stack [kg/h]	Total Mass Flow for two stacks [kg/h]	EU limits [mg/Nm³]
NO_x (**)	150	360	720	200
SO_2	150	360	720	200
Particulate	10	24	48	30

Notes:
Concentrations are evaluated as dry flow at 6% O_2 in Normal Conditions
(*) Monthly average. Any daily averaged emission value will not be higher than 110% with respect to monthly averaged emission values. 95% of all the hourly averaged emission values will not be higher than 200% with respect to monthly averaged emission values
(**) evaluated as NO_2

The foreseen CO_2 emissions are equal to 583 t/h (for one unit operation) at reference condition and with reference coal.

In the following *Table* are reported the flue gas characteristics of stack 1 and 2.

Table 4.6.1b Flue Gas Characteristics

Parameter	Stack1	Stack 2
Emission flow rate at the stack (m^3/h)	2,904,286	2,904,286
Emission flow rate at the stack (Nm^3/h) dry at 6% O_2	2,400,000	2,400,000
Diameter of the stack (m)	7.5	7.5
Flow velocity at the stack (m/s)	18	18
Temperature at the stack (°C)	48	48

4.6.2. *Waste Water*

The plant has three typologies of water discharge:

- waste water treatment plant discharge;
- storm water discharge;
- brine discharge.

The average waste water treatment flow rate discharged to the sea will be about 123 t/h for two units operation (66 t/h for one unit operation), split as:

- 60 t/h from the desulphurization plant (30 t/h for one unit operation);
- 60 t/h from the power island, coming from the effluent treatment plant (33 t/h for one unit operation);
- 3 t/h from the sewage treatment plant (for one unit and two units operation).

Two storm water basins will be provided: one for the power islands areas "first flush" water collection (first 5 mm of rain), the other for the collection of water from potential oil polluted areas. Clean storm water will be collected and released as such to the sea.

The pumped effluent from such basins will be sent to the effluent treatment plant tanks.

Downstream the waste water treatment plant the water discharge will comply with the limit values presented in the following *Table*.

Table 4.6.2a Water Discharge Limit Values

Parameter	M.U.	Power Plant Limit Values	Regulations Limits*
pH	-	6-9	6-9
Oil products	mg/dm^3	10	10
Chrome	mg/dm^3	0.5	0.5
Copper	mg/dm^3	0.5	0.5
Zinc	mg/dm^3	1.0	1.0
Iron	mg/dm^3	1.0	1.0
Chlorine	mg/dm^3	0.2	0.2

* Decision 177/2005 Annex 3

The cooling system will also discharge about 53 m^3/s (26,5 m^3/s for each unit) of sea water, circulating in open cycle.

This water will be discharged in to the sea with a temperature increase of about 8 °C.

To facilitate water discharge and heat diffusion in sea water, two cliffs 140 m long are foreseen.

Moreover after the treatment in the Sea Water Reverse Osmosis Plant, there will be a discharge of brine directly to the sea of about 411 t/h on average (1 Unit operation) and of about 725 t/h on average (2 Units operation). This discharge isn't polluted but has only an increase of salt concentration.

4.6.3. *Noise*

The power plant's activity will introduce new noise sources.

The main sources during the operation period of the plant will be:

- Ultrasupercritical (usc) boiler;
- Coal bunkers (coal mill);
- Main machine hall building;
- Fabric filter;
- Main transformers;
- Air compressors building;
- Coal conveyors;
- Coal towers;
- Demineralization plant;
- Stack;
- Coal floating transfer system.

In *Chapter 6* the sound power levels of the Thermal Power Plant sources are reported and their potential impact on the adjacent areas is evaluated.

4.6.4. *Byproducts*

Byproducts of the Power Plant operation will be gypsum, bottom ashes and fly ashes.

Gypsum will be produced in the desulphurization plant (limestone-gypsum absorber).

Bottom and fly ashes will be produced due to coal combustion. Fly ashes will be captured in the fabric filters and then stored into proper silos. Bottom ashes will be crushed and either recirculated to the furnace, or stored into one proper daily silo.

Gypsum and fly ashes production will be respectively of about 8.5 t/h and about 27.5 t/h for each unit. Considering 8,000 hours per year of operating time, the total quantity produced every year by the plant will be respectively about 140,000 t and 440,000 t (consumption for two units).

Byproducts will be sold to authorised companies and sent mainly by boat from the Power Plant pier; part of the byproducts could remain available for potential Albanian market and be transported by road.

4.6.5. *Solid Waste*

The operation of the Power Plant will produce small quantities of waste.

The main waste typologies will be filters, batteries, accumulators, saturated resins and exhaust oil.

Wastes will be disposed of by authorised companies in accordance with Albanian regulations.

4.6.6. *Traffic*

Power Plant Operation will induce terrestrial and naval traffic mainly to receive raw materials and ship by-products.

Terrestrial traffic will be mainly related to limestone supply, that will be provided by trucks from local quarries (about 120 trucks/month for each unit, equal to about 5 trucks for working day).

Naval traffic will be mainly related to coal supply and by-products shipping.

As reported in *Paragraph 4.3*, the coal will arrive through oceanic boats, that will anchor 2-3 miles offshore.

The anchorage area will be located outside the medium Adriatic naval passage and will be defined in accordance with the competent authorities. This area will be at least on a 20 m depth sea bed, suitable for oceanic boats, and will not have permanent facilities.

The coal will be transshipped to barges and then unloaded on the coast by means of a 950 m long pier. For the coal supply of each unit about 1-2 oceanic boats and 14 movements (go and back) of barges for the coal transshipment and unloading are foreseen per month.

Fly ashes and gypsum will also be shipped by small boats from the Power Plant pier. For them, during two units operation, 7 and 1.5 boats respectively are foreseen per month.

In the following *Figures* the scheme and a view of transhipment are reported.

Figure 4.6.6a Scheme of Transhipment

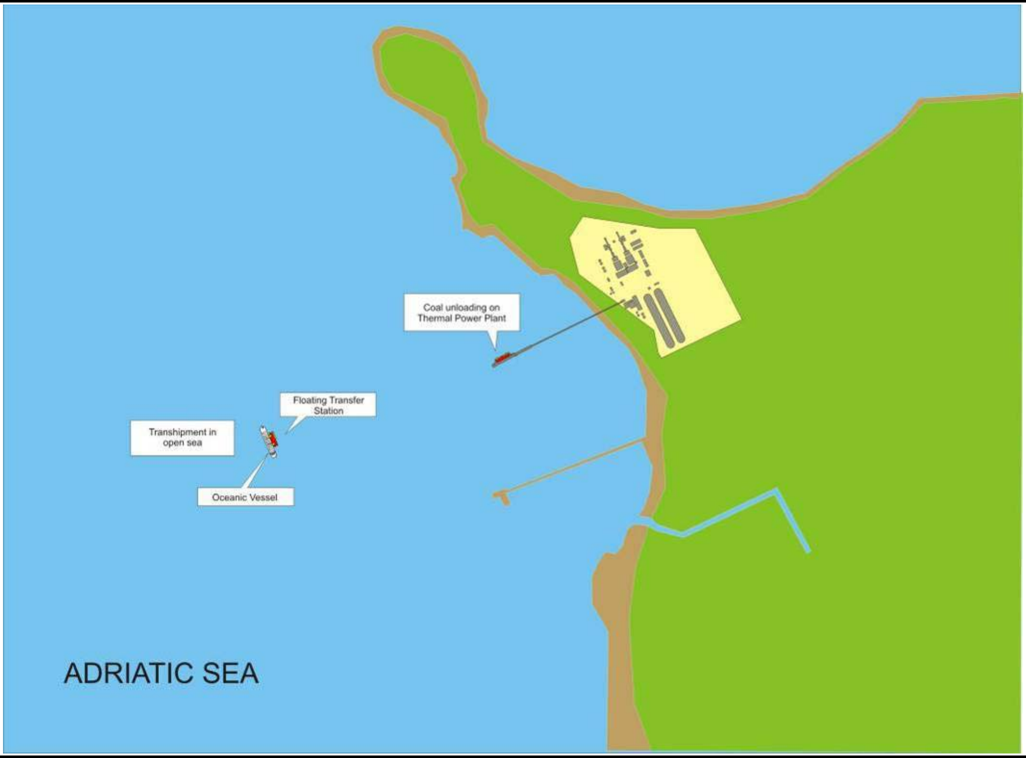


Figure 4.6.6b View of Transhipment

4.7. CONSTRUCTION PHASE

The two units, of 800 MWe each, will be built in two phases.

The construction yard (as reported in *Figure 4.5.1a*) will be located within the fence of the plant and will be fitted with all services necessary to workers.

The workers temporary accommodation will be provided in the construction yard.

Entrance to the construction yard will be provided through new roads, in addition to the existing roads network, sometimes partially widened.

Construction activities are described in the following *Paragraphs*:

- site preparation;
- Power Plant construction;
- raw materials;
- water discharge;
- timing;
- personnel;
- traffic;
- mitigation.

4.7.1. *Site Preparation*

During the preliminary construction phase, top soil for about 0.50 m depth (on the entire site area) will be removed. This soil will be used for subsequent landscaping after the Power Plant construction.

Afterwards, an embankment with compacted material will be laid on the site to achieve a final level of 3 m. a.s.l. in the operation area and 1.0-1.5 m a.s.l. in the construction yard.

Potable and industrial water needs during construction phase will be covered by temporary desalination plants. A sewage treatment plant will be installed to purify construction site domestic waste water, before its discharge to the sea.

In this phase the existing drainage system network will be modified, in order to be functioning both during construction and operation phase.

A medium voltage electrical connection for construction activities (only for the construction of the first unit) has been foreseen from the existing electrical substation. It will be sized for approximately 6 - 8 MW.

The main facilities foreseen in the construction area are the following:

- roads, loading areas and storeyards, connected with the external roads network;
- fencing;
- civil and industrial water feeding;
- storm water network and discharge;

- biological waste water network, treatment plant and discharge;
- MV electrical connection and grounding;
- lighting;
- data and phone network;
- parking areas;
- porter' office, guard, infirmary and changing room;
- offices, laboratories, canteen;
- storehouses.

4.7.2. *Power Plant Construction*

The main phases of the Power Plant construction will be the following:

- main civil works;
- electromechanical assembling;
- painting and insulations.

Due to the particular characteristics of the ground and to the seismicity of the area, different types of foundation will be adopted. In particular, depth foundations are foreseen for some facilities (i.e. power island).

Floating foundations will be used for minor buildings and machineries, made of hollow box-shaped concrete caissons.

Since the groundwater table is close to the ground level, water table lowering could be temporarily required.

Whenever possible prefabricated components (i.e. tunnels, foundation plinths, beams, floors etc.) will be used.

For boiler assembling high capacity lifters (400-800 tons) will be required.

The main foreseen civil work are the following:

- Temporary construction facilities;
- Sea water intake system;
- Sea water intake underground channels;
- Sea water circulating pumps basins (two separate basins, one for each unit) and building;
- Sea water discharge underground channels and diffusor;
- Power island and coal handling machines foundations on deep piles;
- Main machine building;
- Boiler;
- Selective Catalytic Reduction (SCR) system;
- Fabric filter;

- Gas cooler;
- DeSOx;
- Ash silos;
- Auxiliaries island and administrative area floating;
- Chimney internal lining and structure;
- Limestone yard with discharge pit;
- Sheltered gypsum storage building;
- Coal, limestone, ashes and gypsum conveyor belts foundations;
- Coal, limestone, ashes and gypsum conveyor belts steel towers;
- Ashes pneumatic conveying system (from boiler to storage silos) supports and equipment foundations;
- Limestone crushing and milling house with emergency discharge pit;
- Sea water distribution pit;
- Industrial and demi water treatment basins, tanks and relevant buildings;
- Industrial and demi water treatments auxiliary building;
- Sewage collecting pipes, pits and treatment basins;
- Waste water treatment plants, basins, tanks and relevant buildings;
- Waste water treatment auxiliaries building;
- Chemicals retention basins;
- Oil separators pits;
- First flush storm water basins;
- Transformers foundations and basins;
- Start-up oil and gasoil tanks, foundations and oil retention basins;
- Underground civil works (culverts, trenching, cableways, conduits, drainage, sewage, etc.);
- Civil works relevant to:
  - Flue gas sampling system;
  - Condensate treatment system;
  - Fire-fighting system;
- Pipe-rack foundations and steel structure;
- H_2 storage bunker;
- Electrical generator CO_2 storage building;
- Urea to ammonia plant auxiliaries building;
- Warehouse and heavy equipment warehouse;
- Workshop;

- Gatehouse;
- Administration building;
- Canteen;
- Laboratory;
- Chemicals storage building;
- Auxiliary boiler shelter;
- Air compressors building;
- Fence;
- Parking areas;
- Roads and lighting;
- Landscaping.

4.7.2.1. *Works Planning*

With the aim to achieve costs optimization and to avoid future construction constraints, some facilities necessary for the first phase will be already sized or designed in order to be used also for the final plant configuration (post phase two).

In particular, the following facilities will be built in phase one also considering unit two needs (final configuration)

- Auxiliaries building;
- Compressor building;
- FGD slurry temporary storage tank;
- All floating type foundations;
- Limestone storage and handling system;
- Gypsum storage and handling system;
- All auxiliary systems buildings (common to both units);
- Auxiliary boiler;
- Industrial water fire fighting pumps;
- Sea water fire fighting pumps;
- Start-up oil and gasoil tanks.
- conveyor belt system from the pier head to the storage yard (common to both units);
- Water intake system at the pier head (common to both units);
- Discharge channel (common to both units);
- Discharge diffuser (common to both units).

Annex 1 shows the buildings/facilities built in the first and in the second phase.

4.7.3. *Raw Materials*

The site preparation will require about 1,600,000 m^3 of inert material, that will be provided by local quarries, probably those located in Kruja Region at about 45 km from Porto Romano.

Additional 400,000 m^3 of material will be available from the preliminary top soil removal.

For the civil work of each unit 125,000 m^3 of concrete and 12,000 tons of metallic rebars will be required.

For each unit, electromechanical components will be 60,000 tons, insulation material will be about 150,000 m^3.

The water needs during construction phase will be about 500 m^3/day on average.

For water supply during construction artesian wells and a plant will be used.

The drinkable water will be also supplied through a desalination and treatment plant.

4.7.4. *Waste Water*

The waste water will be mainly produced by the personnel presence (biological waste water) and by the storm water collection.

About 150 m^3/day waste water will be sent to the treatment plant and, afterwards, discharged in to the sea, in compliance with the relevant regulations.

4.7.5. *Timing*

For the preliminary organization of the construction phase 3 months will be necessary. Afterwards, each construction phase (one for each Power Plant unit) will last approximately 49 months.

The construction phase of the second unit could start at least 6 months after the beginning of the first unit construction phase.

4.7.6. *Personnel*

During the first unit construction phase approximately 1,000 workers on average will operate at the site, with a peek of about 1,650 workers.

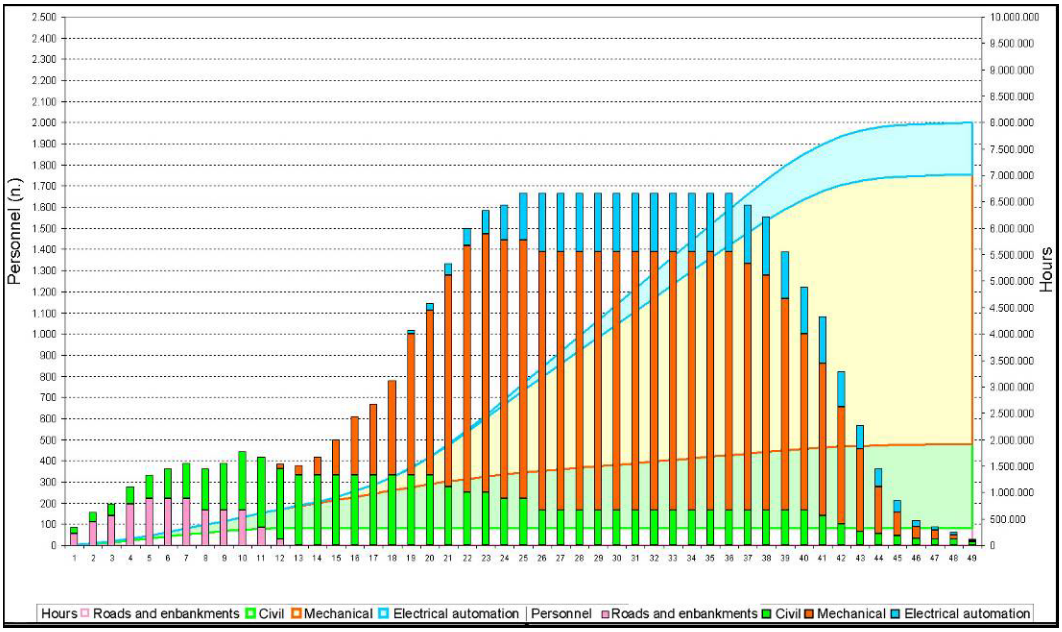
If the second unit construction phase will start 6 months after the beginning of the first phase (as at least foreseen), approximately 1,400 workers on average will operate at the site, with a peek of about 2,500 workers.

An overall man-hour quantity of about 8,000,000 is foreseen for the first unit construction, while 4,000,000 man-hour quantity is foreseen for the second unit construction.

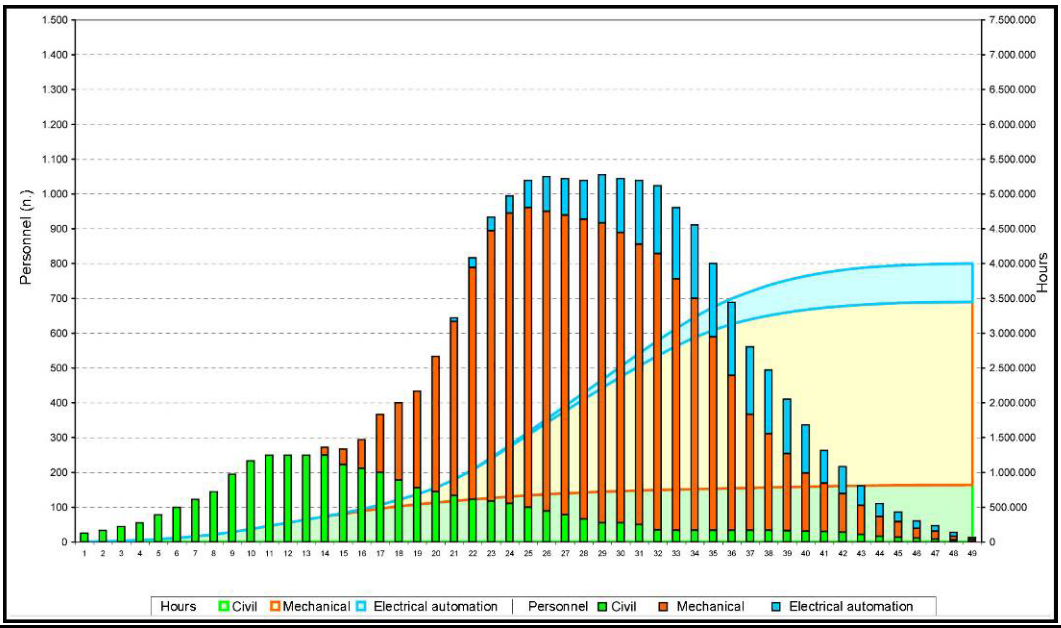
In the following *Figures* the foreseen monthly number of workers for both construction phases is reported.

Figure 4.7.6a *Workforce and Work Hours*

First Phase



Second Phase

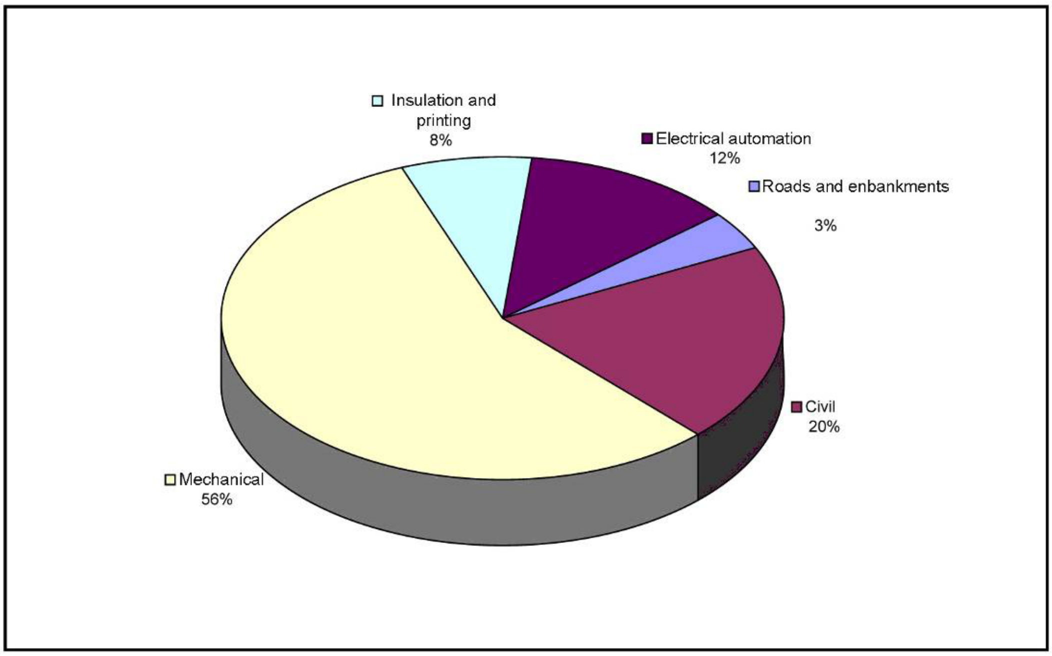


In the following *Figures* the hours work distribution for the different work typologies in the first and second construction phase are shown.

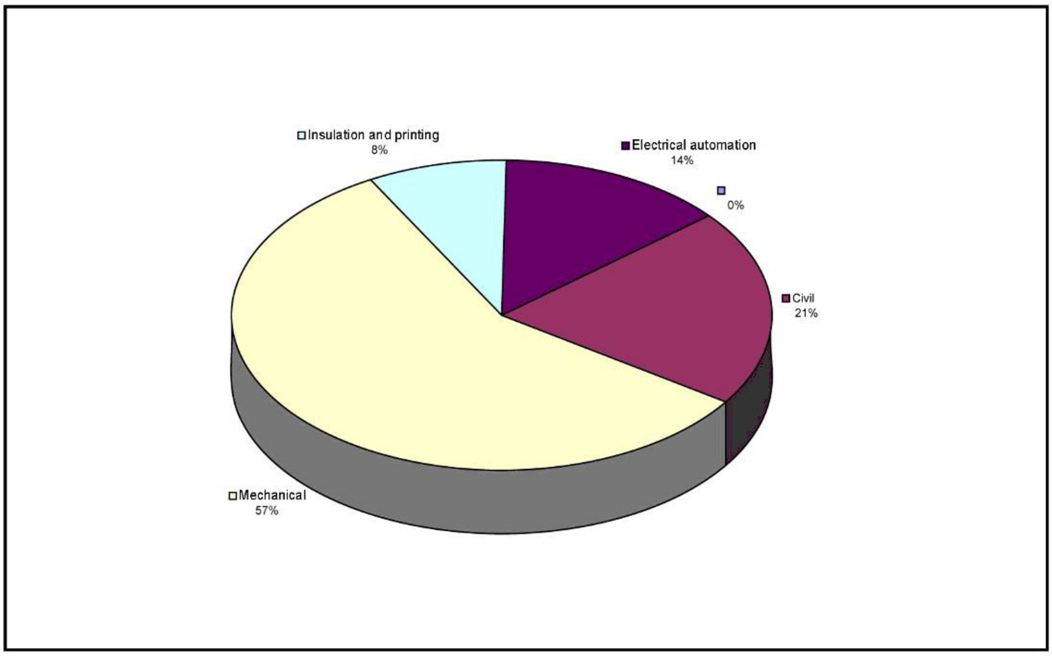
As reported, main activities will be related to mechanical and civil work.

Figure 4.7.6b *Hours Work Distribution by Typologies*

First Phase



Second Phase



4.7.7. *Traffic*

During the Power Plant construction 350 cars/day and 8-10 collective vehicles/day are foreseen for workers transportation.

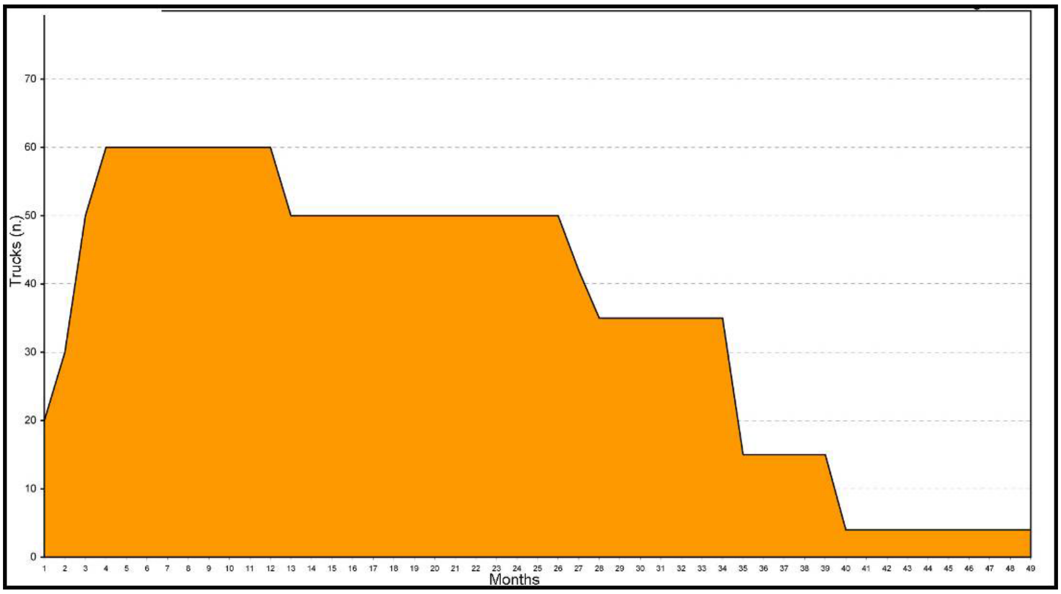
The daily heavy vehicles foreseen for both construction phases for material transportation is reported in the following *Figures*.

As shown in the *Figures*, for the first unit construction the maximum will be about 60 heavy vehicles /day, while for the second unit construction the maximum will be less than 40 heavy vehicles /day.

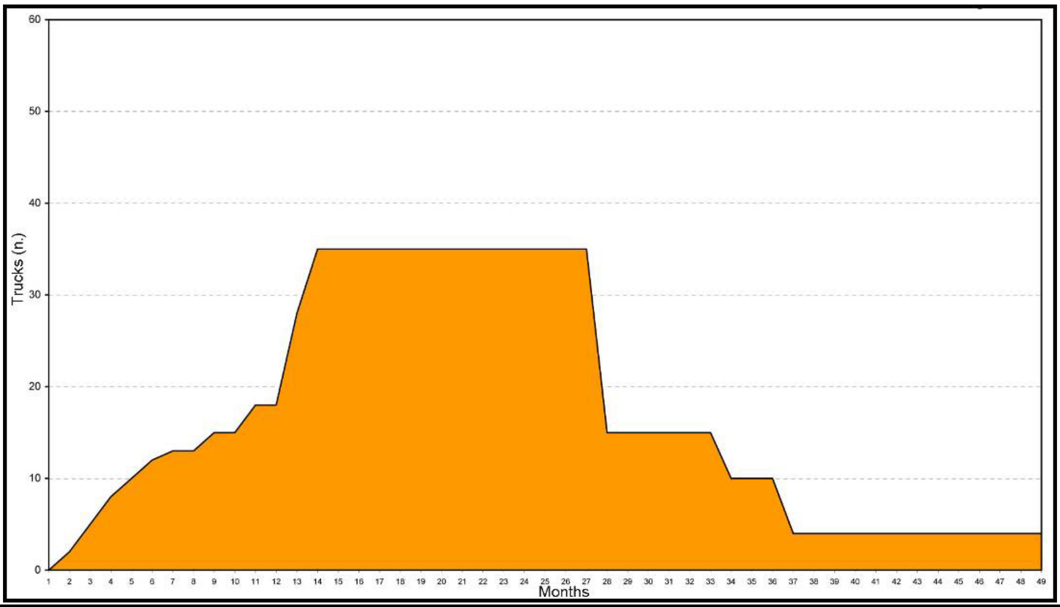
It has to be highlighted that for the preliminary site preparation the Power Plant area has to be raised to + 3.00 m a.s.l, while the construction yard to 1.0-1.5 m a.s.l.. Such activity will require about 200 tracks/day for at least 10 months, for the inert mineral matter transportation. It is also to be highlighted that such activity could be planned before the beginning of the construction activities. In this case it will be possible to achieve a preliminary ground settling and traffic peaks reduction.

Figure 4.7.7a Distribution of Heavy Vehicles

First Phase



Second Phase



4.7.8. *Mitigation*

During construction phase mitigation measures will be adopted to minimise potential impacts on the environment.

In particular, the following main mitigation measures are foreseen:

- roads and loading areas asphalting;
- dirt roads and piles surface wetting;
- vehicular velocity limitation.

During construction phase, periodical measurements of the main air pollutants deriving from the construction activities (Dust) are planned in the areas adjacent to the construction yard. These measurements will be used to verify the compliance with relevant regulations.

4.8. DECOMMISSIONING

The Power Plant lifetime, from an industrial and economic point of view, is evaluated in 40 years. The decommissioning of the Plant could be modified or delayed, considering the economic and technical profit, also by means of *revamping* cycles.

The operation activities are related only to the electric production by means of coal combustion. Considering this kind of Plant area utilization, the land use will not be compromised for others eventual reutilizations.

Considering the possibility to dismiss the plant at the end of its technical life, the following phases are foreseen:

- dismounting and reclamation of the plant and of the equipments;
- demolition of the buildings.

Executive plan will be developed and fixed by competent authorities, about 3 years before the end of the Power Plant operation.

4.8.1. *Dismounting and Reclamation of the Plant and of the Equipments*

This first phase will include all the necessary activities in order to dismount the plant components and to ensure the reclamation of the items which could represent some risks.

This action will be carried out by a qualified company and will consist in cleaning the parts of the plant which have been affected by polluting agents and in disposing the collected waste, in accordance with the relevant regulation. The cleaned plants and equipments will be then left on the site in order to be checked by the competent authorities.

The lubricating oils used within the plant will be sent to authorized disposal companies. Other consumption materials will be given back to their suppliers.

The fuel oil tanks will be cleaned (gas free certified), dismounted and cut in transportable sizes. Iron will be recycled and ground within the containment basins will be subjected to appropriate analysis. If pollution will be found, the soil will be reclaimed and, if necessary, disposed of by authorized companies.

4.8.2. *Demolition of the Buildings*

Once the statement of the reclamation of the plant and of the equipments has been obtained by the competent authorities and after the positive advice on sanitary conditions, it will be possible to submit the specific demolition plan to the competent authority.

After its approval, the metallic structures will be dismounted and the concrete buildings demolished.

These operations, carried out by a qualified company, will consist in the dismounting of the metallic structures, in their reduction in smaller parts, suitable for transportation, and in the mechanic demolition of the reinforced concrete works, using specific operating machines.

The foundations will be demolished up to 0.50 meter of depth from the surface. All demolition materials will be divided according to their typology and recycled according to necessity and possibility.

The metallic materials, including the plant's components and reclaimed equipments, will be recycled, i.e. scrap iron which will be handed over to foundries. The concrete will be handed over to qualified companies who will mince it to separate reinforcing iron from the crumbled concrete. The reinforcing iron will be then recycled like the metallic material, whereas the crumbled one can be recycled as inert building matter.

4.9. FAILURE ANALYSIS

4.9.1. *Methodology*

The present failure analysis has the scope to identify hazards and related risks arising from the activities carried out within the Porto Romano Power Plant and their potential effects on workers' health and safety and on environment.

For any potential hazard identified, control or mitigation measures are taken into account. The risk is, then, established as a combination of probability of a given consequence and a grading of the severity of the same consequence.

4.9.2. *Risk Assessment*

The risk is established qualitatively as a combination of probability of a given consequence and a grading of the severity of the same consequence, by means of the "risk matrix" given in *Table 4.9.6a.*

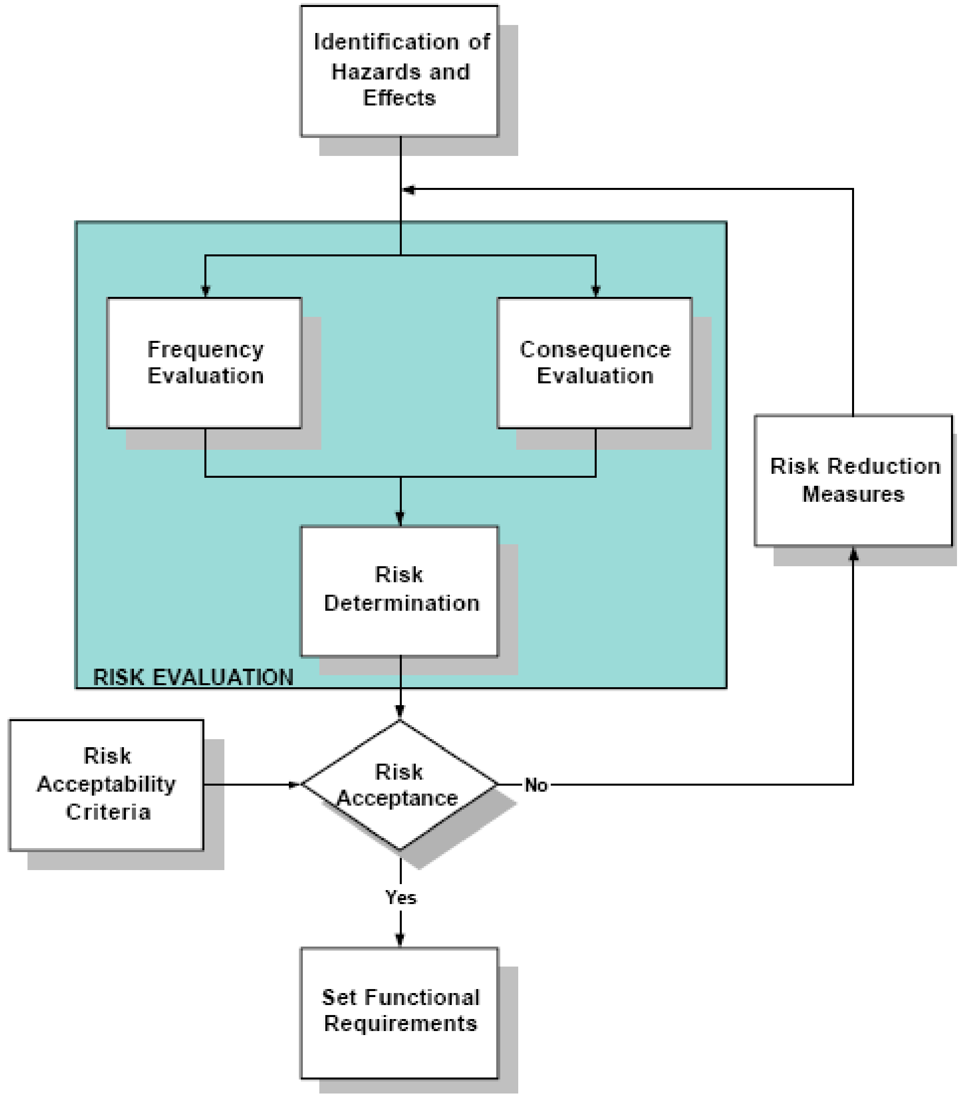
Risk assessment procedure consists of the following activities:

- Identification and definition of hazards and their potential effects;

- Evaluation (assessment) of risks and effects arising from the identified hazards either qualitatively or quantitatively in terms of the likelihood/probability of occurrence and severity of the consequences;
- Assessment of tolerability of risk to personnel, environment, assets and public by comparing risk level with the project relevant acceptance criteria.

The Risk Management Process is represented graphically in the following *Figure*. Guidance on each step is provided in the following sections.

Figure 4.9.2a *Risk Management Process*



4.9.3. *Hazard Identification*

Before the risks associated with a particular activity can be assessed, it is first necessary to systematically identify the hazards which may affect, or arise from, the particular operation under consideration.

For each activity, the most significant hazards should be identified in terms of:

- Potential sources of incidents;
- Human health hazards;
- Environmental hazards;
- Potential sources of economic loss.

Example of HSE aspects to be considered are:

- Fire and explosion;
- Exposure to chemical;
- Asphyxiation and electrocution;
- Human factors;
- Emissions;
- Wastes;
- Noise;
- Vibration;
- Water;
- Atmosphere;
- Ecosystems alteration.

Once the hazards have been identified, the risks they present to personnel, environment, assets and people are evaluated. Risk evaluation requires consideration of both the severity of consequences of the potential hazard and their likelihood.

4.9.4. *Consequence Assessment*

The consequences are those of credible scenarios (taking the prevailing circumstances into consideration) that can develop from the release of a hazard. The consequence estimates are based on envisaged scenarios of what "might happen". Hazards can have consequences in all four consequence categories:

- Personnel: Harm to the health and safety of personnel involved in the Power Plant operations and activities;
- Property Damage and/or Loss of Revenue: Damage to ENEL physical asset and/or impacts on projects (failure to meet project objectives) and/or production losses;
- Environmental: Damage to the environment deriving from ENEL operational activities or from incidents
- Public: Damage to the general public.

It is important to remember that most activities which carry some degree of risk, entail risk to more than one of the above categories. All possible effects of a hazard must be considered together.

Refer to *Table 4.9.4a* for detailed definitions of the consequence categories.

Consequences are classified qualitatively by means of five severity degrees:

- minor;
- moderate;
- major;
- critical;
- catastrophic.

Table 4.9.4a *Consequence Assessment*

	Consequence of Hazard				
Category	**Minor (Mi)**	**Moderate (Mo)**	**Major (Ma)**	**Critical (Cr)**	**Catastrophic (Ca)**
Ranking	**1**	**8**	**16**	**50**	**100**
Personnel	Minor onsite injuries (first aid and non-disabling, reportable injuries).	Serious onsite injuries (temporary disabling worker injuries).	One permanent disabling onsite injury or fatality.	Two to three onsite fatalities or four permanent disabling injuries.	Four or more onsite fatalities and/or disabling injuries.
Property Damage and/or Loss of Revenue	Property damage and/or loss of revenue less than 500K$.	Property damage and/or loss of revenue from 500K$ to 10 M$.	Property damage and/or loss of revenue from 10 M$ to 25 M$.	Property damage and/or loss of revenue from 25 M$ to 100 M$.	Property damage and/or loss of revenue in excess of 100 M$.
Environmental	No remediation.	Cleanup/ remediation is immediate; no lasting impact on food chain, terrestrial and/or aquatic life.	Cleanup/ remediation complete within 1 year; minor impact on food chain, terrestrial and/or aquatic life.	Cleanup/ remediation requires more than 1 year; moderate impact on food chain, terrestrial and/or aquatic life.	Cleanup/ remediation may not be possible; major damage to food chain, loss of terrestrial and/or aquatic life.
Public	No offsite impact/damage.	Minor offsite impact (noise, smoke, odour, etc). Possible adverse public reaction.	Moderate offsite impact limited to property damage and/or minor health effects. Adverse public reaction.	Major offsite property damage or short term health effects on the public. Major public concern/ reaction.	Public fatality and/or serious injury; or extensive offsite property damage. Severe adverse public reaction threatening facility operation.

Notes:
1. Assets are understood as referring to: the oil and gas reservoirs, production facilities, pipelines, money, capital, and other company, contractor and third-party property.
2. Incidents relating to air, noise, light, and soil vibrations should be assessed on the basis of expert judgement and, in case of uncertainty, local expertise may be called in.

4.9.5. *Frequency of Occurrence of Accident Scenarios*

The frequency estimates are based on historical information that such a scenario has happened under similar conditions in the same business and/or within ENEL, knowing full well that circumstances will never be exactly the same.

In order to assure a certain degree of consistency in the scenarios likelihood assessment, the likelihood scale definitions are provided in *Table 4.9.5a*.

Table 4.9.5a Likelihood of Accident Scenario Categorization

Likelihood of Occurrence					
Category	**Insignificant (Is)**	**Remote (R)**	**Infrequent (If)**	**Occasional (O)**	**Frequent (F)**
Ranking	**0.5**	**1**	**2**	**5**	**10**
Quantitative	Less than 1 x 10^{-6} pa	Between 1 x 10^{-6} and 1 x 10^{-4} pa (e.g. multiple instrument or valve failures; or human errors; or spontaneous tank or vessel failures)	Between 1 x 10^{-4} and 1 x 10^{-3} pa (e.g. combination instrument failures and human errors; or full bore of process lines of fitting)	Between 1 x 10^{-3} and 1 x 10^{-2} pa (e.g. dual instrument or valve failures and human errors; hose ruptures; piping leaks)	Gteater than 1 x 10^{-2} pa (e.g. single instrument valve failures; hose leaks; or human error in every day activities)
Layers of Protection	Four or more independent, highly reliable safeguards in place; failure of three safeguards would not initiate an unwanted event	Three independent, highly reliable safeguards in place; failure of two safeguards would not initiate an unwanted event	Two independent, highly reliable safeguards in place; failure of one safeguards would not initiate an unwanted event	Single level, highly reliable safeguards in place to prevent an unwanted event	Procedures and/or operator interface relied upon to prevent an unwanted event
Hazard Scenario	Should not occur during the life of the process, and there is no industry experience to suggest it will occur	Similar events are likely to occur somewhere within this industry during the life of this general type of process	Likely to occur somewhere within this industry during the life of this general type of process	Will almost certainly occur within this industry during the life of this general type of process (but not necessarily at this location)	Has occur somewhere within this industry in this specific type of process and/or is likely to occur at this location during the life of the facility

Notes:
1. For quantitative studies, use either 'hazard scenario' or 'layers of protection' criteria
2. For semi-quantitative or quantitative studies, use 'quantitative' criteria
3. Indipendent, highly reliable safeguards should consider common cause failures, failure rates, mean time between failures, plant experience, and maintenance or protective devices

4.9.6. *Risk Matrix*

Having determined the likelihood of the different scenario and the consequences arising from that event, it is possible to represent the severity of the risk graphically using a Risk Matrix.

ENEL, on the basis of the principle above exposed, has developed the following Risk Assessment Matrix (*Table 4.9.6a*) where:

- the vertical axis represents the measure of likelihood of the occurrence of an undesired event. The scale of likelihood from "0.5" to "10" is used to indicate the increasing likelihood;
- the horizontal axis represents the consequence severity that could occur with that event. The scale of consequences from "1" to "100" is used to indicate increasing severity.

The intersection of the chosen column with the chosen row is the risk level. The overall risk is classified according to which of the consequences has the highest rating.

The numbers in each box of the matrix give an index of the severity of the determined risks and a priority order for their management. High numbers correspond to more severe risks which need to be managed firstly.

Table 4.9.6 a Risk Matrix

Probability of occurrence of the accident event		Consequence category				
		1	8	16	50	100
		Minor	Moderate	Major	Critical	Catastrophic
0,5	Insignificant	A	A	B	B	C
1	Remote	A	B	B	C	D
2	Infrequent	A	B	C	D	D
5	Occasional	A	C	C	D	D
10	Frequent	B	C	D	D	D

Each of the three colored regions in the Risk Matrix identifies the limits of risk acceptability/tolerability. The three different colors classify risks as Low, Medium or High.

Table 4.9.6b Risk Acceptability Criteria

CLASS A: The level of risk is acceptable and generic control measures are required to avoid deterioration.	LOW RISK (Continuous Improvement)
CLASS B – C: The level of risks can be acceptable only once risk-reduction measures have been identified and implemented. The risk is acceptable if it is demonstrated that it is "As low as reasonably practicable" (ALARP).	MEDIUM RISK (Risk reduction Measures/ALARP)
CLASS D: The level of risk is not acceptable and risk control measures are required to mitigate the effects and to move the risk level to the "yellow" area. Complementary risk analysis required (QRA, HAZOP etc.)	HIGH RISK (Intolerable Risk)

4.9.7. *Major Risks Associated to the Power Plant*

After the identification of the possible hazards that could occur in the Power Plant, the most representative – so called "top events" – are listed in the following *Table 4.9.7a* , together with the assessment of the related risks, based on the application of the procedure previously described.

As it can be seen, most of the identified accident scenarios are classified as A or B or C risk category.

For hazards categorized as B and C risk, all control and mitigation measures will be undertaken in order to minimize, respectively, the likelihood and the consequence coming from such events.

Executive design will be developed in compliance with all applicable requirements and international standards.

Table 4.9.7a *Risk Assessment Porto Romano Power Plant*

N°	Identified Hazard	Consequence	Control measures	Risk ranking Cons.	Prob.	Risk Category
1	Coal storage and auxiliaries					
1.1	Self heating of coal stored in the coal yard	Fire and formation of smokes containing pollutant compounds (CO, etc.)	Operating procedures (compacting, moving, wetting etc.) – fire fighting systems (e.g. IR detectors)	8	5	C
1.2	Self heating inside pulverizer (during start up or shut down) or presence of coal already in self heating conditions, coming from the storage	Fire risk inside the equipment	Operating procedures – Purging of pulverizers – Steam inertization	8	2	B
1.3	Flammable mixture inside the coal conveyors system	Possible coal dust fire risk	Operating procedures – Cleaning of the belt system -	8	2	B
1.4	Self heating in coal bunker	Fire and formation of smokes containing pollutant compounds (CO, ecc.)	Operating procedures – fire fighting systems	8	5	C
2	Coal ultrasupercritical boiler					
2.1	Failure of feed control system, with consequent flammable mixture inside the combustion chamber or presence of coal in self ignition conditions	Internal coal dust explosion, with consequent blast waves and missiles formation. Risk for personnel. Equipment damage	Control systems and automatic emergency shut down systems. System redundancy.	16	0.5	B
2.2	Main lube oil system fire	Radiation with consequent risk for exposed personnel. Damage of equipment	Automatic fire detection system.	8	1	A
3	Steam vaporizers					
3.1	Overpressurization of steam vaporizers, due to loss of level or malfunction of pressure control systems	Physical explosion with missiles formation. Risk for personnel. Equipment damage	Steam vaporizers are provided with pressure safety valves and automatic emergency shut down systems. Operating procedures	50	0.5	B
4	Steam piping					
4.1	Loss of containment of pressurized steam due to leaks (Flange, junction, System sealing)	Risk for personnel to be impacted by high temperature steam (skin contact).	Personnel provided with proper PPE (Personal Protective Equipment) – Inspection and maintenance plan.	8	1	B

N°	Identified Hazard	Consequence	Control measures	Risk ranking		
				Cons.	Prob.	Risk Category
5	Steam turbine					
5.1	Mechanical failure of turbine (blades rupture)	Possible missiles formation with consequent risk for personnel. Possible damage to equipment	Equipment located inside a dedicated building. Turbine is provided with alarms and emergency shut down systems. (high vibrations, high temperature etc.)	1	0.5	A
5.2	Main lube oil system fire	Radiation with consequent risk for exposed personnel. Damage of equipment	Automatic fire detection system. Fractioned water injection	8	1	A
6	Auxiliary boiler					
6.1	Failure of feed control system, with consequent flammable mixture inside the combustion chambre	Fire risk.	Control systems and automatic emergency shut down systems. Inspection and maintenance plan.	8	0.5	A
7	Emission reduction system (NOx)					
7.1	Emission to environment beyond legal limits, in consequence of malfunction of reduction emission control system (Water Injection).	Increase of out spec emission to the environment (NOx).	System interlock - Operating procedures – Analysis of emissions. Control system	1	1	A
8	Compressor					
8.1	Main lube oil system fire	Radiation with consequent risk for exposed personnel. Damage of equipment	Automatic fire detection system.	8	1	B
9	Light oil and heavy oil tanks					
9	Loss of containment of oil from tanks	Possible fire with consequent damage to personnel and equipment. In case of no ignition, risk of pollution of the groundwater	Operating procedures - Fire detection system – Fire fighting systems – Basin containment with retaining wall	16	1	B
10	Transformer					
10.1	Fire of transformer oil	Radiation with consequent risk for exposed personnel. Damage of equipment	Automatic fire detection system - Fire protection walls - Fractioned water injection - Internal hydrogen controls	8	1	B

4.10. PRELIMINARY IDENTIFICATION AND EVALUATION OF IMPACTS

By analysing the project, different aspects having potential interferences on the environment have been identified for the construction and the operation phases.

In order to simplify the readability of foreseen interferences, different tables with the main potential impacts due to construction and operation phases are presented in the following *Paragraphs*.

A detailed description of potential impacts is reported in Chapter 6.

Environmental aspects analyzed in this study are reported below:

- Air;
- Soil;
- Surface Water and Groundwater
- Noise;
- Vegetation, Flora, Fauna and Ecosystems;
- Landscape;
- Traffic;
- Non Ionizing Electromagnetic Fields;
- Socioeconomic Framework;
- Public Health.

4.10.1. *Air*

Steam Boiler flue gas represents the main source of air pollutants emission; the auxiliary boiler has to be considered as an occasional emission source.

Flue gases will be discharged into the atmosphere through a 150 m high stack for each unit.

Moreover, coal and limestone piles represent a potential source of dust, caused by piles wind erosion and handling.

During construction phase the main aspects regarding dust emissions are material handling and wind erosion.

Table 4.10.1a Air Potential Interferences

Project Phase	Potential Interference	Area of Influence	S/D/P*	Prevention Methods
Construction Phase	*Dust production* caused by material handling and wind erosion	Construction yard and access road network	NS T R	Pile surfaces will be wetted to minimise the total particulate emissions from the materials storages
Construction Phase	*Dust production* caused by material movements and transportation	Construction yard area and access road network	NS T R	Main roads will be asphalted
Operational Phase	*Air Pollutants Emissions* from the stack of the plant	Investigated Area	S P R	Utilization of the Best Available Techniques
Operational Phase	*Dust Emission* From Coal and Byproducts Handling	Investigated Area	S P R	Close conveyors to move coal and Byproducts, water sprinklers to wet coal stored

Note:
* S/D/P: Significance, Duration, Persistence
S = Significant; NS = Not Significant
T = Temporary; P = Permanent;
R = Reversible; NR = Not reversible

4.10.2. *Soil*

The construction of Porto Romano Thermal *Power Plant* could have potential impacts on soils and subsoils, mainly related to topsoil removal and deep excavation, subtraction of land to other uses.

During operation main potential impacts are related to soil contamination due to accidental pollutants spills, release of sludge, oil, hydraulic fluid, paint, solvents and other similar materials.

Table 4.10.2a Soil Potential Interferences

Project Phase	Potential Interference	Area of Influence	S/D/P*	Prevention Methods
Construction Phase	*Top soil removal and deep excavations*	Construction Yard	NS T R	Material will be used to raise the site, to build up a wind breaker to partially protect the coal storage area and for landscaping
Construction Phase	*Release of sludge, oil, hydraulic fluid, paint, solvents and other similar materials*	Construction Yard	NS T R	All storage areas (chemical tanks, light oil and heavy fuel oil tanks, ashes silos area, limestone storage area, gypsum storage, waste water storage areas, lubricant oil storages) will be paved or equipped with containment basins of adequate capacity
Operational Phase	*Land subtraction*	Power Plant area	NS P R	Limited areas involved into grazing and agricultural activities

Note:
* S/D/P: Significance, Duration, Persistence
S = Significant; NS = Not Significant
T = Temporary; P = Permanent;
R = Reversible; NR = Not reversible

4.10.3. *Surface Water and Groundwater*

The main significant potential impact on groundwater during construction phase is connected with foundations. Since groundwater is found at a depth close to the ground level, water table lowering could be temporarily required.

During operation phase the presence of containment systems, paved surfaces and storm water collection will minimise the potential impacts on groundwater.

The main potential impacts during the construction phase are related to: release of sludge, oil, hydraulic fluid, paint, solvents and other similar materials; the potential impacts on sea water are related to the naval traffic.

During operation phase potential impacts are related to the thermal water discharge, water utilization and waste water discharge.

Table 4.10.3a Surface Water and Groundwater Potential Interferences

Project Phase	Potential Interference	Area of Influence	S/D/P*	Prevention Methods
Construction Phase	*Water utilization. Release of sludge, oil, hydraulic fluid, paint, solvents and other similar materials. Waste water discharge. Naval traffic*	Construction Yard, Sea close to the construction yard	NS T R	The waste water will be treated before discharge into the sea. Security procedures will be applied.
Operational Phase	*Thermal discharge; water utilization and waste water discharge.*	Sea close to the construction yard	S P R	Waste Water Treatment Plant, Waste Water Storage Tanks, Biological Waste Water Treatment Plant

Note:
* S/D/P: Significance, Duration, Persistence
S = Significant; NS = Not Significant
T = Temporary; P = Permanent;
R = Reversible; NR = Not reversible

4.10.4. *Noise*

During the construction phase, main potential impacts are related to machinery noise emissions.

The sound sources in this phase will be not continuous and they will depend on the number and type of machinery used for each activity.

During operation phase an increment on the noise level is expected.

Impacts related to vibrations are not expected.

Table 4.10.4a Noise Potential Interferences

Project Phase	Potential Interference	Area of Influence	S/D/P *	Prevention Methods
Construction Phase	*Noise due to machineries*	Adiacent area to the construction yard	NS T R	Prescriptions to contractors about noise performances of machineries
Operational Phase	*Noise derived by Power Plant activities and operation*	Adiacent area to the construction yard	NS P R	Noise survey will be realised to verify the compliance to the relevant regulations

Note:
* S/D/P: Significance, Duration, Persistence
S = Significant; NS = Not Significant
T = Temporary; P = Permanent;
R = Reversible; NR = Not reversible

4.10.5. *Vegetation, Flora, Fauna and Ecosystems*

The area directly occupied by the Power Plant is characterised by the presence of salt and ruderal vegetation. Due to the limited extension of the involved natural area, it can be considered that the occupation of natural habitats will not have a significant impact on the natural ecosystem of the area.

The main potential impacts of the Power Plant on ecosystems are related to air emission and thermal water discharges.

Table 4.10.5a Vegetation, Flora, Fauna and Ecosystems Potential Interferences

Project Phase	Potential Interference	Area of Influence	S/D/P*	Prevention Methods
Construction Phase	*Soil utilization*	Construction yard	NS P R	-
Operational Phase	*Air Emission:* deposition of pollutants on the ground	Investigated area	S P R	Utilization of the Best Available Techniques
	Thermal Water Discharge	Large Scale	NS P R	Sea water temperature measurements will be carried out to verify the compliance with the relevant regulations

Note:
* S/D/P: Significance, Duration, Persistence
S = Significant; NS = Not Significant
T = Temporary; P = Permanent;
R = Reversible; NR = Not reversible

4.10.6. *Landscape*

Potential impacts are related to the construction on a green field of Power Plant Buildings and Facilities.

Table 4.10.6a Landscape Potential Interferences

Project Phase	Potential Interference	Area of Influence	S/D/P*	Prevention Methods
Operational Phase	*Plant Presence*	Investigated area	S P R	Volumes Containment

Note:
* S/D/P: Significance, Duration, Persistence
S = Significant; NS = Not Significant
T = Temporary; P = Permanent;
R = Reversible; NR = Not reversible

4.10.7. *Road Network and Naval Traffic*

During construction phase the local road network will be modified and improved in order to facilitate the access to the construction yard.

During construction phase about 1,600,000 m^3 of material will be transported by trucks to the site. The transportation will be relevant but distributed in a long period.

During the operation phase local roads will be characterized by an increase in traffic due to workers vehicles and material transportation.

During construction phase no significant naval traffic is foreseen, while during operational phase a more consistent naval traffic is expected due to the transportation of coal, gypsum and ashes.

Table 4.10.7a Traffic Potential Interferences

Project Phase	Potential Interference	Area of Influence	S/D/P*	Prevention Methods
Construction phase	*Increasing in trucks number*	Roads network close to the construction yard	S T R	Modification and enlargement of the existing road network
Operational Phase	Increase in local working personnel traffic Increasing in trucks number Increasing in naval traffic amount	Roads network close to the construction yard	NS P R	Modification and enlargement of the existing road network

Note:
* S/D/P: Significance, Duration, Persistence
S = Significant; NS = Not Significant
T = Temporary; P = Permanent;
R = Reversible; NR = Not reversible

4.10.8. *Ionizing and not Ionizing Radiations*

No significant impacts related to the Power Plant construction and operation are foreseen.

The only external electromagnetic sources of the Power Plants are:

- a 400 kV power line, about 26 km long, which connects the power station to Tirana 2 National Grid Power Station;

- a 500 kV DC undersea cable, about 210 km long, which goes to Italy, not included in the present Study.

The analysis of the Power Stations, the Power Line to Tirana 2 Station and the undersea cable to Italy is presented in separate Environmental Impact Assessment Studies.

4.10.9. *Socioeconomic Framework*

During construction and operation phase a large number of local personnel will be required with significant positive impacts on socioeconomic framework.

The Porto Romano Power Plant electricity availability will also promote Albanian industrial development.

4.10.10. *Public Health*

Impacts on public health are related to the secondary effects of impacts on air quality and noise.

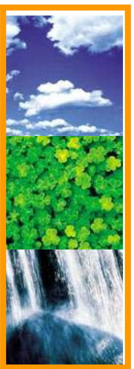
During the Power Plant construction, the potential impacts on Public Health can be related to the noise generated by vehicles and machineries, and dust emission mainly caused by materials movements.

The potential impacts on Public Health during operation phase can be related to stack emissions and to Power Plant noise emission.

Table 4.10.10a Public Health Potential Interferences

Project Phase	Potential Interference	Area of Influence	S/D/P*	Prevention Methods
Construction phase	*Air pollution and noise emission*	Site and adjacent areas	NS T R	Security Procedures during yard activities
Operational Phase	*Air pollution*	Investigated area	NS P R	Utilization of the Best Available Techniques
	Noise Emissions	Adjacent areas to the Power Plant	NS P R	Noise survey will be carried out to verify the compliance to the relevant regulations

Note:
* S/D/P: Significance, Duration, Persistence
S = Significant; NS = Not Significant
T = Temporary; P = Permanent;
R = Reversible; NR = Not reversible



5

5. ENVIRONMENTAL BASELINE

5.1. ATMOSPHERE AND AIR QUALITY

The analysis of the atmosphere included two activities:

- Climatology characterization;
- Local Air quality analysis.

5.1.1. *Climatology*

The Albanian Coast climate is typically Mediterranean with mild, wet winters and warm, sunny and rather dry summers. Inland conditions vary depending on altitude but the higher areas are rather cold and frequently snowy in winter; here cold conditions and snow cover may linger into spring.

Compared to other Mediterranean areas the precipitation in the country is rather heavy; coastlands are quite wet in winter and mountain areas are among the wettest European regions.

Midsummer months are generally sunny but the fine weather can be interrupted by occasional thundery downpours. Exteremly hot conditions occur rarely on the coast and are mitigated by sea breezes. Winter conditions on the coast are generally mild but occasional cold winds from the north and east may chill the atmospheric conditions for a few days when the mountains inland are covered with snow.

When a warm humid wind - the sirocco - blows from the southwest or south, conditions may feel oppressive. This is particularly the case in autumn when Mediterranean Sea temperatures are at their highest. The sirocco often precedes wet weather and a return to cooler temperatures.

In the inland and in the mountains the annual sequence of weather conditions is similar to the coast but the summers are cooler and less humid. During the stormy conditions of autumn and winter, rain may be heavy and cold and snow severe.

In order to characterize in a more site-specific way the climatology of the *Power Plant* area, data used in this *Paragraph* have been collected from the *Institute of Hydrometeorology of Tirana Academy of Science.* The averaging period is 30 years (years of start and end of the monitoring period are not specified).

There is only one meteorological station in the investigated area, located in Durrës , which measures the following parameters: Temperature, Relative Humidity, Precipitations and Wind Speed. The monthly averages of these parameters are reported in the following tables.

Table 5.1.1a Monthly Air Temperatures [°C]

Station	1	2	3	4	5	Month 6	7	8	9	10	11	12	Year Average
Durrës	8,3	9,0	11,0	14,2	18,2	21,8	24,0	23,9	21,4	17,6	13,4	9,8	16,0

Table 5.1.1b Monthly Relative Humidity [%]

Station	1	2	3	4	5	Month 6	7	8	9	10	11	12	Year Average
Durrës	69	68	68	71	72	70	68	68	70	68	72	70	70

Table 5.1.1c Monthly Precipitations [mm]

Station	1	2	3	4	5	Month 6	7	8	9	10	11	12	Year Average
Durrës	110,6	91,4	95,2	76,3	50,8	38,7	23,9	34,8	62,5	101,1	132,9	113,0	931,2

Table 5.1.1d Monthly Wind Speed [m/s]

Station	1	2	3	4	5	Month 6	7	8	9	10	11	12	Year Average
Durrës	3,9	4,1	4,2	4,0	3,5	3,4	3,3	3,2	3,1	3,3	3,9	4,0	3,7

The values in the previous *Tables* confirm the typically Mediterranean climate, in fact the average temperature is about 8/9 °C in winter months and reaches the highest values in July. The relative humidity is generally around 70%, whereas the heaviest rains occur from October to January.

Table 5.1.1d shows the constant presence of the wind, during all the year, in fact, the monthly average value of wind speed is always bigger than 3 m/s.

5.1.2. *Air Quality*

This paragraph provides an overview of the Albanian and European legislation on air quality, relevant for the *Porto Romano Power Plant*. The limit values are compared with the pollutant concentrations measured at Durrës air quality station.

5.1.2.1. *Legislation*

The main regulation concerning air quality, as reported in *Chapter 3*, are:

- *Directive 1999/30/EC* of the European Council of 22 April 1999 relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air;
- *Directive 2008/50/EC* of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe;

- *Albanian Decision No. 803* on air quality norms issued in December 2003 that establishes the limit values for atmospheric pollutants.

With regard to sulphur dioxide, nitrogen dioxide and particulate matter, the *Directive 2008/50/EC* maintains the limit values of the former *Directive 99/30/EC*. Limit concentrations in *Table 5.1.2.1a* are referred to a temperature of 293 K and pressure of 101,3 kPa.

Table 5.1.2.1a European Limit Value

Pollutant	Typology	Value
SO_2	alert threshold*	500 µg/m³
SO_2	hourly limit value for the protection of human health not to be exceeded more than 24 times a calendar year	1 January 2005: 350 µg/m³
SO_2	daily limit value for the protection of human health not to be exceeded more than 3 times a calendar year	1 January 2005: 125 µg/m³
SO_2	limit value for the protection of ecosystem. Calendar year and winter (1 October to 31 March)	19 July 2001: 20 µg/m³
NO_2	alert threshold*	400 µg/m³
NO_2	hourly limit value for the protection of human health not to be exceeded mare than 18 times a calendar year	1 January 2005: 250 µg/m³ 1 January 2006: 240 µg/m³ 1 January 2007: 230 µg/m³ 1 January 2008: 220 µg/m³ 1 January 2009: 210 µg/m³ 1 January 2010: 200 µg/m³
NO_2	annual limit value for the protection of human health. Calendar year	1 January 2005: 50 µg/m³ 1 January 2006: 48 µg/m³ 1 January 2007: 46 µg/m³ 1 January 2008: 44 µg/m³ 1 January 2009: 42 µg/m³ 1 January 2010: 40 µg/m³
PM_{10} Stage 1	24-hours limit value for the protection of human health not to be exceeded more than 35 times a calendar year	1 January 2005: 50 µg/m³
PM_{10} Stage 2**	24-hours limit value for the protection of human health not to be exceeded more than 7 times a calendar year	1 January 2010: 50 µg/m³
PM_{10} Stage 1	annual limit value for the protection of human health. Calendar year	1 January 2005: 40 µg/ m³
PM_{10} Stage 2**	annual limit value for the protection of human health. Calendar year	1 January 2005: 30 µg/m³ 1 January 2006: 28 µg/m³ 1 January 2007: 26 µg/m³ 1 January 2008: 24 µg/m³ 1 January 2009: 22 µg/m³ 1 January 2010: 20 µg/m³

** measured over three consecutive hours at locations representative of air quality over at least 100 km² or an entire zone or agglomeration, whichever is the smaller.*
*** Indicative limit values to be reviewed in the light of further information on health and environmental effects, technical feasibility and experience in the application of Stage 1 limit values in the Member States.*

The *Directive 99/30/EC* also introduces the criteria for the most appropriate location of sampling points applied to fixed measurements. For macroscale siting, sampling points directed to the protection of human health should be sited to be representative of air quality in a surrounding area of no less than 200 m² for traffic-pollution oriented monitoring sites and of several square kilometres at urban-background atmospheric conditions monitoring sites.

Sampling points targeted at the protection of ecosystems or vegetation should be sited more than 20 km from settlements or more than 5 km from other built-up areas, industrial installations or motorways. As a guideline, a sampling point should be sited to be representative of air quality in a surrounding area of at least 1.000 km^2.

Finally, the *Annex VII* shows the criteria to determine the minimum numbers of sampling points for fixed measurements of concentrations of sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air.

The protection of human health includes different criteria for diffuse and point sources. For the assessment of pollution in the vicinity of point sources, the number of sampling points for fixed measurement should be calculated by taking into account emission densities, the likely distribution patterns of ambient-air pollution and the potential exposure of the population.

The *Annex 1* of the *Albanian Decision No. 803* sets maximum allowed concentrations for atmospheric pollutants in open air environments. The limit values can be classified as Primary or Secondary Standard, the first one is applied to sensitive groups of population as children, elderly people, etc…, while the second one aims at the protection and preservation of public health, animals, building etc.…

The Albanian limit values concerning the pollutant considered in this study (SO_2,NO_2,SPM) are shown in *Table 5.1.2.1b*.

Table 5.1.2.1b Albanian Limit Value

Pollutant	Typology	Value	Type of Standard
SO_2	annual average value	35 µg/m³	Secondary(**)
SO_2	hourly average value	360 µg/m³	Secondary(**)
SO_2	daily average value	120 µg/m³	Primary(*)
NO_2	annual average value	60 µg/m³	Primary and Secondary(*)(**)
NO_2	hourly average value	250 µg/m³	Primary(*)
NO_2	4-hours average value	95 µg/m³	Secondary(**)
PM_{10}	annual average value	60 µg/m³	Primary and Secondary(*)(**)
PM_{10}	daily average value	150 µg/m³	Primary and Secondary(*)(**)
$PM_{2,5}$	annual average value	15 µg/ m³	Primary and Secondary(*)(**)
$PM_{2,5}$	daily average value	65 µg/ m³	Primary and Secondary(*)(**)

(*)is applied to sensitive groups of population as children, elders, etc…
(**)aims at the protection and preservation of public wellbeing, animals, building etc…

5.1.2.2. *Air Quality in the Investigated Area*

Very little data are available for the investigation area. The only available source of data is the document "*Air Quality in Durrës City 2005 – 2007 Year*" issued by *Instituti i Studimeve Ambientale (ISA)*, which refers to measurements recorded at Durrës air quality station located in the city centre, close to the polyclinic (see *Table 5.1.2.2a*).

Albanian *DCM n. 803/2003* sets limits for the annual average concentrations of all pollutants listed in *Table 5.1.2.2a*.

Table 5.1.2.2a Durrës – Annual Average Concentrations of Pollutants at Polyclinic Station

Year	SPM [µg/m³]	PM_{10} [µg/m³]	SO_2 [µg/m³]	NO_2 [µg/m³]	O_3 [µg/m³]	Pb [µg/m³]
2005	201	91	16	22	98	0,29
2006	201	93	19	24	106	0,28
2007	211	100	15	23	99	0,26
Albanian limits	*140*	*60*	*35*	*60*	*65*	*1*
EU limits	-	*40*	*20*	*40*	-	*0,5*

According to the report "*Air Quality in Durrës City 2005 – 2007 Year",* which focuses on the problem of high particle content in the urban air of Durrës , during the period 2005-2007, average annual concentrations above the limits were measured only for Ozone, SPM (Suspended Particulate Matter) and PM_{10}.

Directive 1999/30/EC defines annual average limits for PM_{10}, SO_2, NO_2 and Pb. The annual average of the measurements for SO_2, NO_2 and Pb at Durrës monitoring station are in compliance with the limits, while PM_{10} values higher than the limit were measured during 2005-2006-2007.

High levels of SPM concentrations are connected with traffic emissions (PM_{10} and other fine particles like $PM_{2,5}$) and resuspended particles coming from the road dust (particles with diameter more than 10 microns), while the tropospheric ozone formation is the result of air pollution from internal combustion engines and power plants that release nitrogen oxides (NOx) and volatile organic compounds (VOC), by-products of burning gasoline and coal. NOx and VOC combine chemically with oxygen to form ozone during sunny, and high-temperature days, frequent on Durrës area.

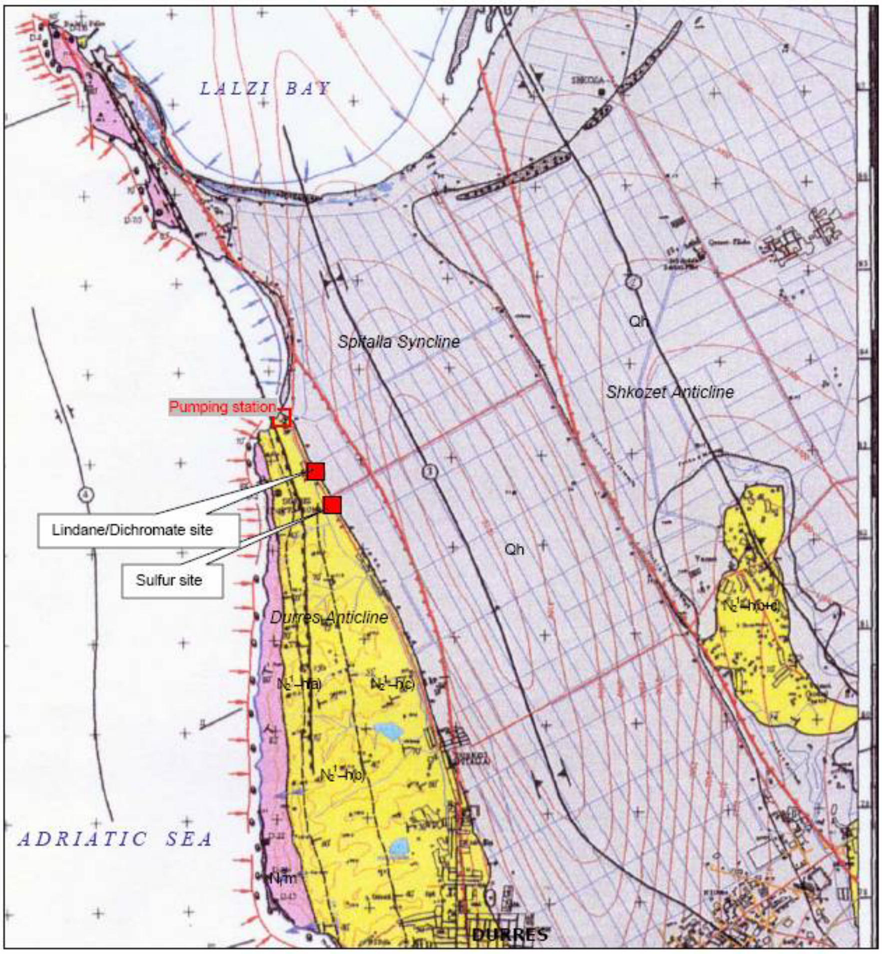
5.2. SOIL

5.2.1. *Geological and Geomorphologic Settings*

The area of Durrës belongs to the so called Ionian Geological -Tectonic Zone, which is characterized by the thick sedimentary deposits of the Low Triassic age. The central western part of the Ionian Zone consists of the Pre-Adriatic Depression, which includes also the wide Durrës area. The Pre-Adriatic Depression is characterized by the presence of some hilly slopes which represent the anticlines and some flat areas which represent the synclines. This depression is filled up mainly of Neogene sediments consisting of clay, marls, conglomerate and sandstone often formed as flysch deposits.

Two significant geologic structures are identified in the study area (*Figure 5.2.1a*): the Durrës anticline and Spitalla syncline, related respectively to the Durrës hills and to the Durrës plain. An active longitudinal tectonic fault separates both structures and is responsible for the high seismological activity in the area. This fault is considered one of the active Albanian faults, as shown in *Figure 5.2.1b*. The precise position of the fault in the area close to the site is shown in the geological map (*Figure 5.2.1a*).

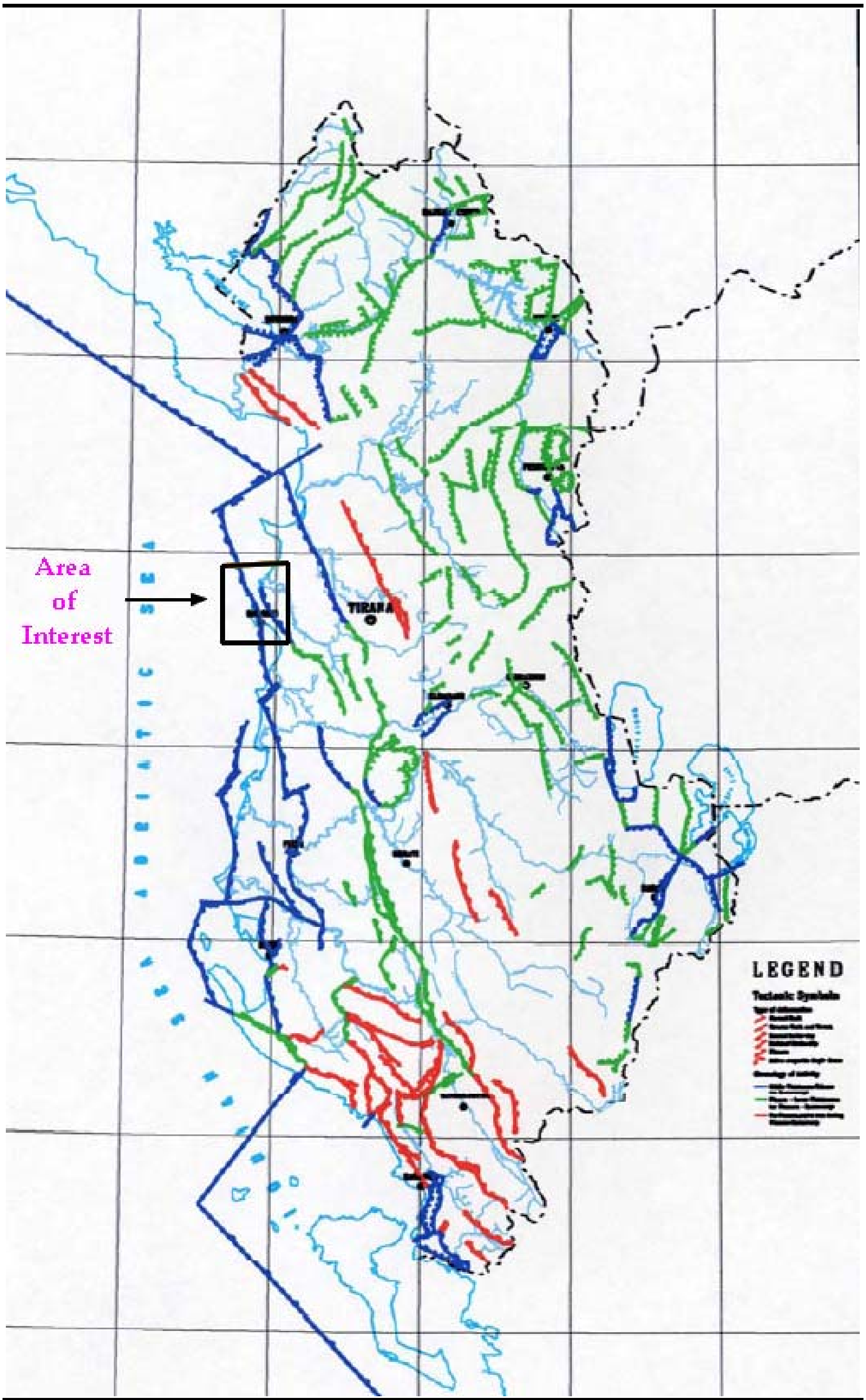
Figure 5.2.1a *Geological Map*



LEGEND

Qh	Holocene, mainly marsh and alluvial deposits, clay, sand and gravel
N_2^1–h(b+c)	Pliocene, Helmesi Formation, clay sandstone and less conglomerate
N_2^1–h(c)	Pliocene, Helmesi Formation, mainly clay and sandstone
N_2^1–h(b)	Pliocene, Helmesi Formation, clay and sandstone lenses
N_2^1–h(a)	Pliocene, Helmesi Formation, sandstone, conglomerate and clay
N_1^3m	Neogene, Mesinian, clay, siltstone, and gypsum

Figure 5.2.1b Main Active Albanian Faults



The Durrës anticline is formed of Miocene formations and of Pliocene deposits which steep deeply to the east with angles of about 60° to 70°. Miocene deposits are formed of Mesinian molasses (N_1^3m) outcropping in the western side of Durrës hills, as well as in Bishti Palles hills. They consist of clay, siltstone, sandstone and some gypsum and their total thickness is about 3000 m.

Spitalla syncline is developed in the plain area of former Durrës marsh. The upper part of the syncline is filled up of Pliocene (Helmesi Formation) and Quaternary deposits.

Helmesi Formation (N_2^1h) is the local name of the lower part of the Pliocene deposit. It forms most of central and eastern part of the Durrës hills and is separated on three horizons: the lower horizon (N_2^1ha), made of sandstone, conglomerate and clay, the middle horizon (N_2^1hb) and the upper horizon (N_2^1hc) made mainly of clay with some sandstone lenses. The total thickness of Helmesi Formation is about 1200-1300 m.

Thin Quaternary deposits, formed mainly by sandy clay deposits, with a maximum thickness of about 3.0 m, cover the old rocks of Durrës hills.

These deposits are of different genesis, like alluvial, marsh deposits and marine deposits. The total maximum thickness of Quaternary deposits in Spitalla syncline (plain) is about 130 m. Alluvial deposits (alQh) overlay on the Helmesi Formation deposits and on most of the Spitalla Syncline (plain) and are tapped at depths below 50-60 m. They present intercalations of gravel, sand, clayey sand and clay. Their maximum thickness is about 70 m, while the thickness of the gravel layers vary from 1-2 m to about 20 m.

Above the alluvial deposits lay the recent Holocene lagoon deposits (lQ_4h_2), which outcrop on the Spitall plain (ex Durrës Marsh). They consist mainly of fine grained sediments like clay, clayey loam, sand and organic matter. Their maximum thickness in the centre of the former Durrës marsh (Spitalla plain) is about 50 m.

Recent Holocene marine deposits (dQ_4h_2) are found along the Porto Roman Beach and Lalzit Bay. They are made of sandy and sandy clay deposits whose maximum thickness is about 20 m. The marine sandy deposits cover also all the wide area of Waste Storage site in Bishti Palles.

The coastal area north of Durrës close to Porto Romano has two different settings.

North of Porto Romano in the Lalzit bay the shoreline is low and mainly sandy. The Erzeni River Delta is characterized by evident marks revealing erosion processes. The coast in this part of the bay is withdrawn of about 800 meters. South of the Erzeni Delta an evident advance is assessed by aerial photo (*Figure 5.2.1c*).

Figure 5.2.1c *Coastal Erosion Movement nearby the Erzeni River Delta (white line represents the previous coast line)*

North West and South West of Porto Romano, erosion phenomena are leading to an increase in the sea water level and/or subsidence, as evident in the position of the bunkers (*Figure 5.2.1d*).

Figura 5.2.1d *Erosion Phenomena East of Porto Romano*

5.2.2. *Seismicity*

Albania is a Balkan country with a high rate of seismicity.

The Albanian orogen lies on the south-westernmost part of the Eurasian plate and is a convergent zone due to the northeastward movement of the Adriatic plate (Adria microplate). The orogen is divided into two domains of the present-day tectonic regime: a coastal domain of compression, dominated by northwest to north-northwest striking thrusts and faults, and an interior domain of extension, dominated by north-striking normal faults (*Figure 5.2.2a*).

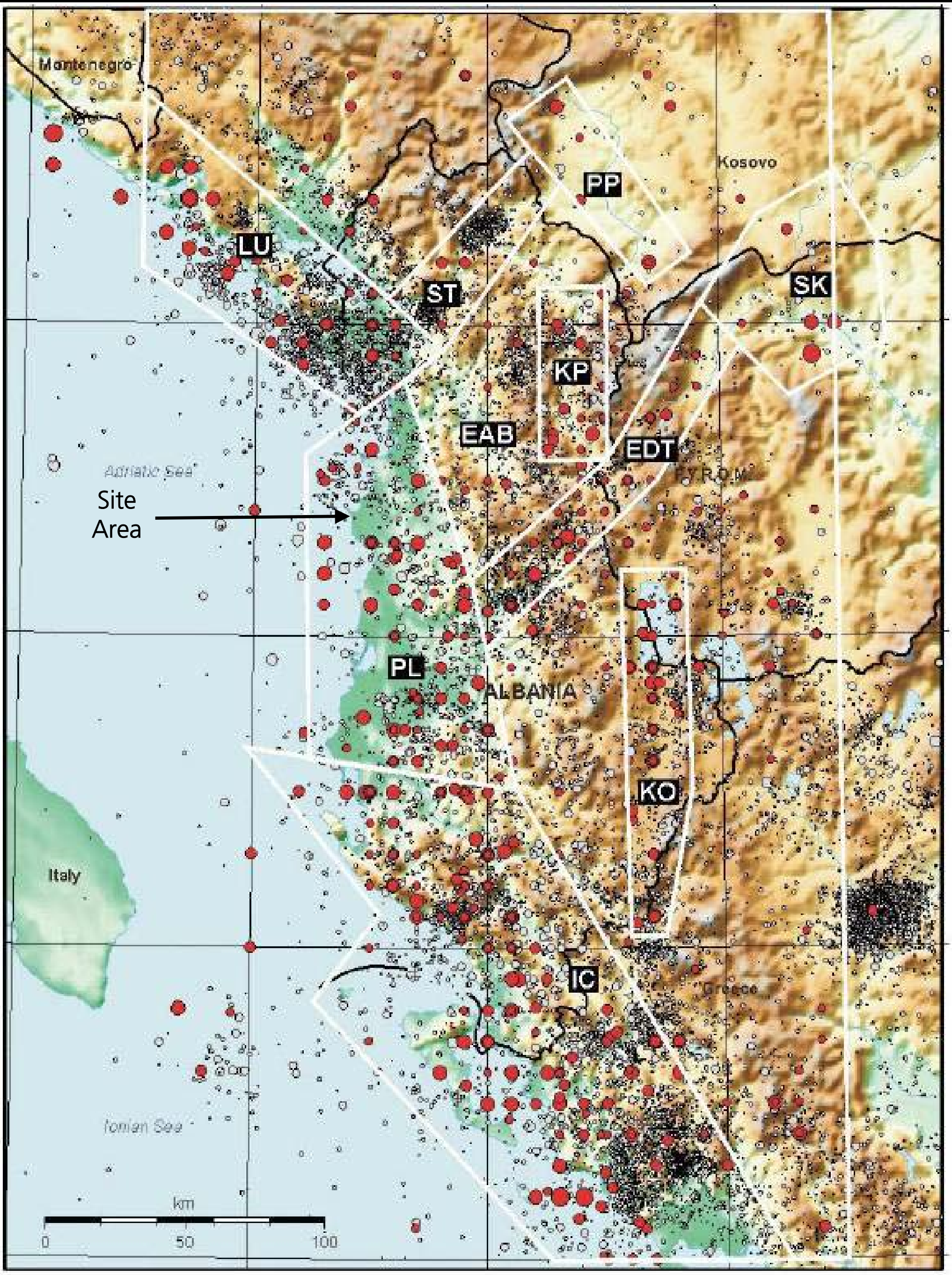
The regional seismicity of Albania has been divided into 7 seismic sources:

- Lezha-Ulqini (LU), a coastal zone containing pre-Pliocene WNW-striking pure-compression thrust faults that run parallel the Dalmatian coastal offshore line. The thrust faults are cut by rare ENE-trending strikeslip faults;
- Periadriatic Lowland (PL), a coastal zone containing post-Pliocene oblique-compression thrust faults, N to NNW-striking, which are cut by rare ENE-trending strike-slip faults;
- Ionian Coast (IC), a coastal zone containing pre-Pliocene NW-striking pure-compression thrust faults, which are cut by rare strike-slip faults;
- Peja-Prizreni (PP), an interior zone, containing three normal fault systems, N-ENE- and WNW-trending, along the boundaries of Dukagjini Pliocene-Quaternary Depression;
- Kukesi-Peshkopia (KP), an interior zone containing Pliocene-Quaternary N-trending normal-fault controlled grabens;

- Ohrid-Korca (KO), an interior zone containing the Pliocene-Quaternary normal-fault controlled Ohrid graben and Korça and Erseka half-grabens, which are generally N-trending;
- Shkodra-Tropoja (ST), a transverse interior zone containing NE-striking normal faults, mainly along the boundary of Mirdita ophiolite zone.

The site area is inside the PL Seismic Zone, close to the LU Zone, as shown in *Figure 5.2.2a*. *Figure 5.2.2b* presents the depth and magnitude of earthquakes in Albania. The maximum magnitude recorded in the area is 7.2. Until 2000 the most intense earthquake registered in the site area had a magnitude between 6 and 7.

Figure 5.2.2a Regional Seismicity



Albanian Seismicity

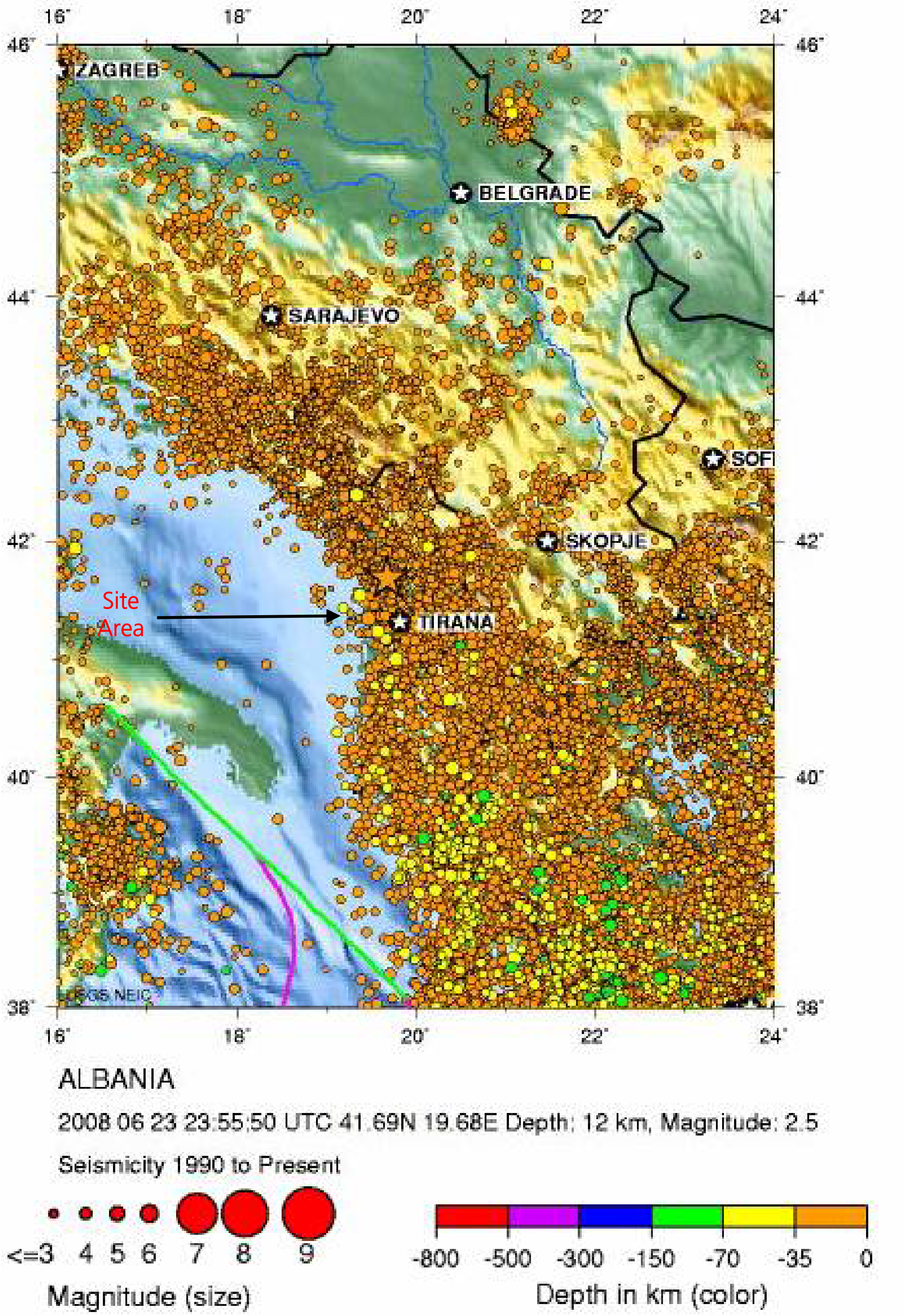
Red - historical unified catalogue (used for hazard determination) Grey - recent catalogue

M < 2.0 · M 2.0 - 2.9 · M 3.0 - 3.9 ∘ M 4.0 - 4.9 ○ M 5.0 - 5.9 ○ M 6.0 - 6.9 ○ M 7.0+

Historical unified Catalogue - all earthquakes larger or equal to Ms 4.5 to the end of 2000

Recent Catalogue - all earthquakes for the period 1964-2000 inclusive

Figure 5.2.2b Depth and magnitude of Albanian Earthquakes until 2000



5.2.3. *Topsoil*

The most widespread topsoil types of Durrës Plain are the following:

- Marsh clayey loam deposits;

- Marsh fine sand deposits;
- Marine sandy deposits.

Marsh clayey loam deposits are developed mostly in the central and in the southern part of the Durrës Plain. The maximum recorded thickness of the marsh clayey loam deposits is about 12 m. The loamy deposits contain also sandy layers or lenses, whose thickness is usually not more than 2-3 m. These deposits are characterized by a very low permeability and low geotechnical properties.

Marsh fine sand deposits are widely developed in the area of the former Durrës marsh area. Usually they underlay the clayey loam deposits and their thickness is from about 2 to 8 m. They have high salt content and low geotechnical soil properties.

The sandy marine deposits are developed along the Adriatic Sea shoreline and partially below the marsh deposits. The depth of the first gravely aquifer, which is covered by very low permeable layers, is more then 50 m from the ground surface. At such conditions the aquifer layers are protected from the potential infiltration of surface pollution.

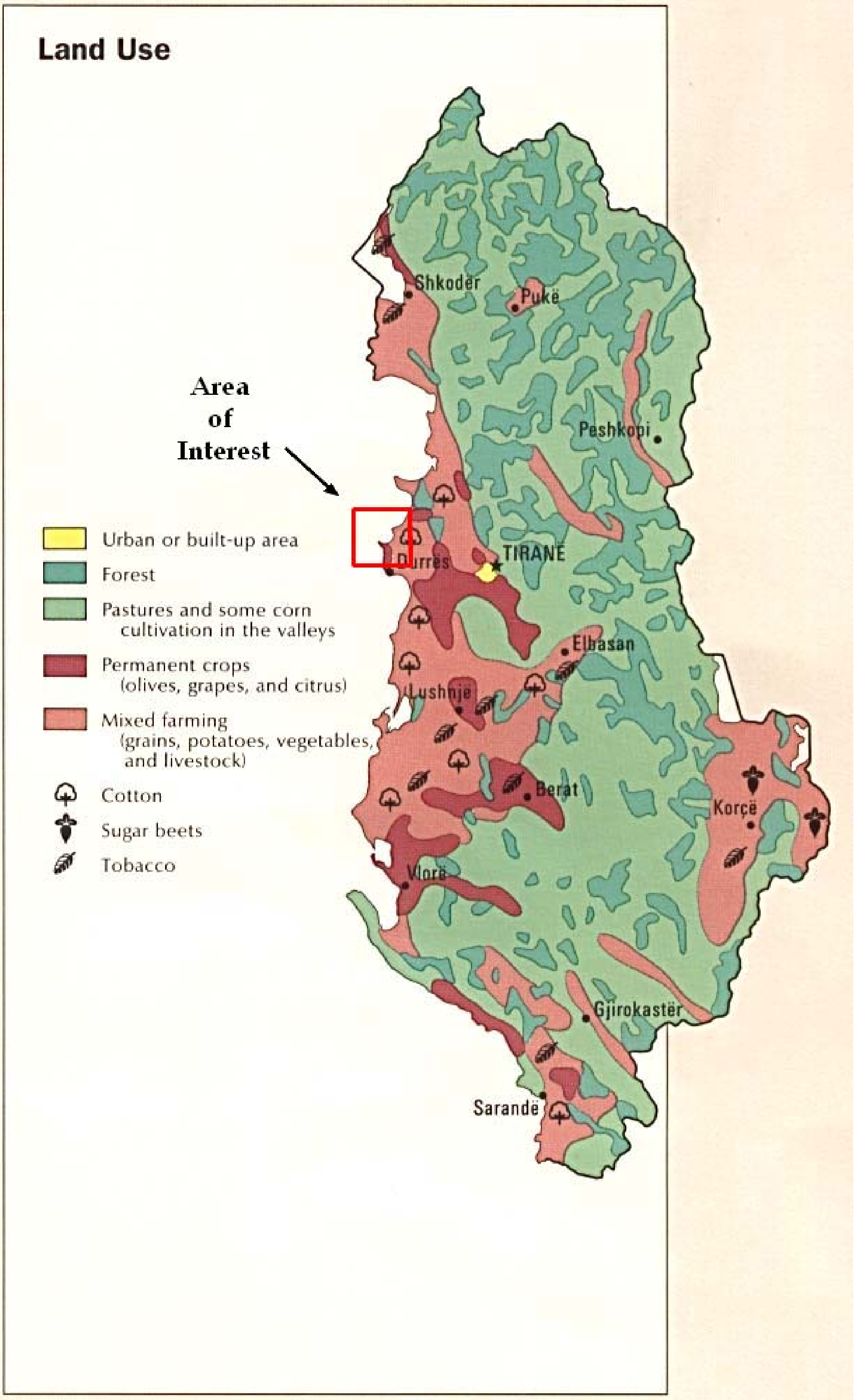
5.2.4. *Land Use*

The site selected for the new Thermal Power Plant is located north of Durrës close to the "Kep I Palit" peninsula. This area is characterized by a mean altitude, lower than the sea level. In the 50'-60' a drainage system to prevent floodings in the area was built. Before the 60' the entire area was characterized by the presence of marshes.

Nowadays the area north of Durrës is mainly characterized by the following land uses (*Figure 5.2.4a*):

- *Agricultural fields*: main cultivations are maize and vegetables. On the hilly reliefs south of Porto Romano and North East of Durrës some vineyards and orchards are present;
- *Grassland and Shrubland:* they are quite widespread. These areas are used for non intensive breeding (cattle, sheep and chicken);
- *Urban Areas*: Except for Durrës , residential areas represent a small percentage in the area north of Durrës . Porto Romano area is characterized by the presence of industrialized settlements, mainly storage areas, pier areas and dismissed chemical plants. A Sulphur Plant is located 6.5 km north of the centre of Durrës city. The plant covers an area of approximately 7.8 ha and is located on the eastern flanks of the Durrës hills, connected to the city through a paved road, on its western side. A Lindane/Dichromate Plant is located 200 m north of the Sulphur Plant. The plant covers an area of approximately 8.2 ha and is located on the eastern flanks of the Durrës hills, connected to the city through a paved road, on its eastern side. A Dumpsite is located 15 m north of a Pumping Station used to discharge water, taken from the canal system, to the sea. The area is approximately 1.000 m^2 and is located on the eastern side of the road connecting Porto Romano to Bishti Palles. A Waste Storage Area is located 2.5 km north of the Pumping Station. The area is approximately 7.600 m^2 and is located on the isthmus of Bishti Palles, on the western side of the road.

Figure 5.2.4a   Land Use of Albania



5.2.5. *Soil Quality*

The North-Western part of the Durrës plain is characterized by the presence of industrial sites.

During the week 17-24 September 2000, a UNEP mission visited Albania to assess the environmental conditions in the aftermath of the Kosovo conflict.

In Durrës Plain two hotspots sites and two highly-polluted sites were identified. The hotspot sites were former industrial facilities. One hotspot was the chemical waste storage, located approximately 10 km north of the centre of Durrës City, at the southeast foot of the Bishti Palles Cape. In this hotspot there were three storage buildings overloaded with chemicals like carbon disulfide, methanol, dimethylamine, HCH residue etc. The second hotspot was the chromate plant, the chromate dumpsite and the lindane at the former Durrës chemical plant, located about 6.5 north of the centre of the city of Durrës and less then 1 km south of Porto Romano. The site was located on the Durrës Plain, at the foot of Durrës Hills. The chromate waste was dumped between the former chemical plant and the drainage channels, in a layer approximately 1.5-2 m high. Until 1990, the former chemical plant in Durrës produced sodium dichromate, for leather tanning, and pesticides, such as lindane (gamma-HCH) and thiram. Both productions processes have been idle since that time and the plant's buildings have been totally destroyed. When the plant was operating, it produced 6-10 tons of lindane per year.

UNEP analyses showed extremely high levels of technical HCH mixtures in the area of the plant and in storage facilities located two kilometres away. UNEP samples identified tetra-penta-, hexa- and hepta-chlorinated cyclohexanes, in which the hexachlorinated isomers were dominant.

A UNEP soil sample taken from the lindane production area contained 8.79 g/kg of HCH isomers (2.4 g/kg of a-HCH; 2.0 g/kg of b-HCH; 3.14 g/kg of g-HCH; 1.29 g/kg of d-HCH). The content of heptachlorinated cyclohexane was 10%, the tetra- and pentachlorinated cyclohexane 5 %. The sample also contained 0.172 g/kg of tri- and tetrachlorinated benzenes.

A soil sample taken in the area of the former dichromate plant (about 20 m from the lindane production process) contained HCH-isomers in the following quantities: 1.1 mg/kg of a-HCH, 0.71mg/kg of g-HCH and 0.4 mg/kg of d-HCH. An inorganic analysis carried out on the same sample found 317 mg/kg of chromium.

About 1 km far from the plant is a settlement. A canal flowing from the former plant passes the settlement and flows through the pump station into the Adriatic Sea. The sediment sample taken from the canal (15 m from the beach) had a content of: Cr: 24 mg/kg; Cr(VI): < 1 mg/kg. Another sediment sample taken from the flood area had 264 mg/kg of Cr and < 1 mg/kg of Cr(VI).

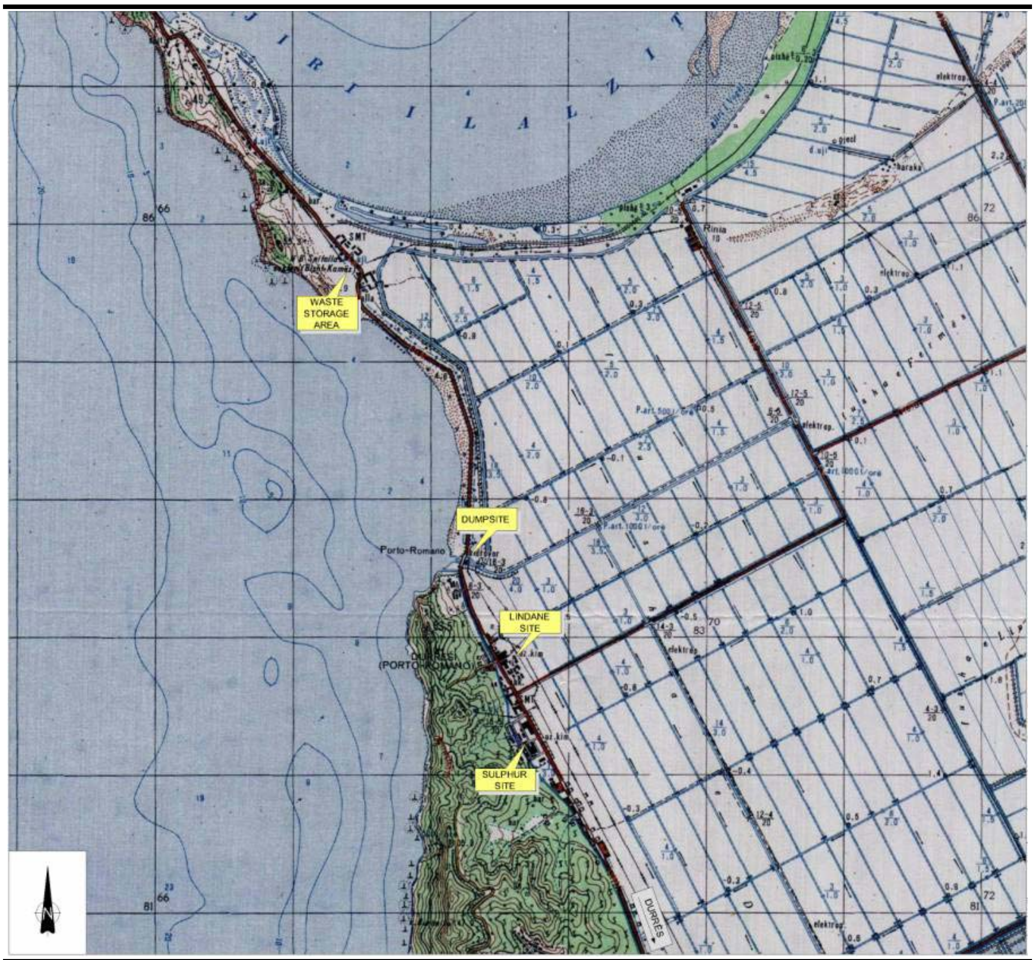
In 2005 GKW Consulting performed an investigation that included groundwater, surface water, soil, soil gas, building material and biomass sampling in various parts of the site.

The results of the soil and sediment sampling undertaken in 2005 show levels of total HCH above the critical value for remediation (PRL= 50 mg/kg) at the Lindane/dichromate site, the surrounding settlements, the sulphur site, the dump near the pumping station, the drainage channels and the road east of the sulphur site. The highest samples were found at the Lindane/dichromate site (428,908 mg/kg and 673,800 mg/kg) and at the sulphur site (13460 mg/kg).

Total chromium was also found above the critical value for remediation (PRL= 1,000 – 2,000 mg/kg) at the Lindane/dichromate plant (highest total chromium concentration: 18,780 mg/kg) and in the drainage channels sediment (2,216.8 mg/kg). Hexavalent chromium was found above remediation standards (PRL= 10 mg/kg) at the Lindane/dichromate plant, with a maximum concentration of 5,270 mg/kg.

In 2007, investigations were performed by ERM S.p.A. and SWS srl in the hot spot sites in Porto Romano (*Figure 5.2.5a)*, in order to characterize soil, groundwater and building materials quality.

Figure 5.2.5a Hot Spot Sites, 2007 Survey



In the Sulphur Site, the sulphur content in the soil samples ranges between 0.04 and 71 mg/kg and is never too high. The content of pesticides (<0.50mg/kg) is also generally negligible except in the vicinity of a former mixing and loading station, where very high values (18 mg/kg) of Lindane were recorded.

Concerning the Lindane Site, the highest content of Chromium (III) in soil samples was equal to 10000mg/kg. Concentrations ranging between 4100 mg/kg and 7800 mg/kg were found in the north of the lindane site, outside the so called bentonite wall, at a depth varying from 0 to 0.6 m. The highest Cr (VI)-content was about 230 mg/kg at the surface. Very high values of HCH were only found in one soil sample, at depths from 0,0 to 0,8 m, and in a sediment sample (45 mg/kg α-HCH). Very high values of DDE and DDT were also found in a soil sample at 0,8 m from the surface. Moreover, very high concentrations of HC (14000 mg/kg) were found at a depth of 0.5 -0.9 m.

The Dump Site samples are nearly free of pollution except for high iron and manganese contents. The chromium values are higher than normality and could originate from dumping activities.

The waste storage area represents the closest site to the study area. 2007 investigations revealed high concentrations of DDE, DDT and HCH (especially Lindane).

5.3. SURFACE WATER AND GROUNDWATER

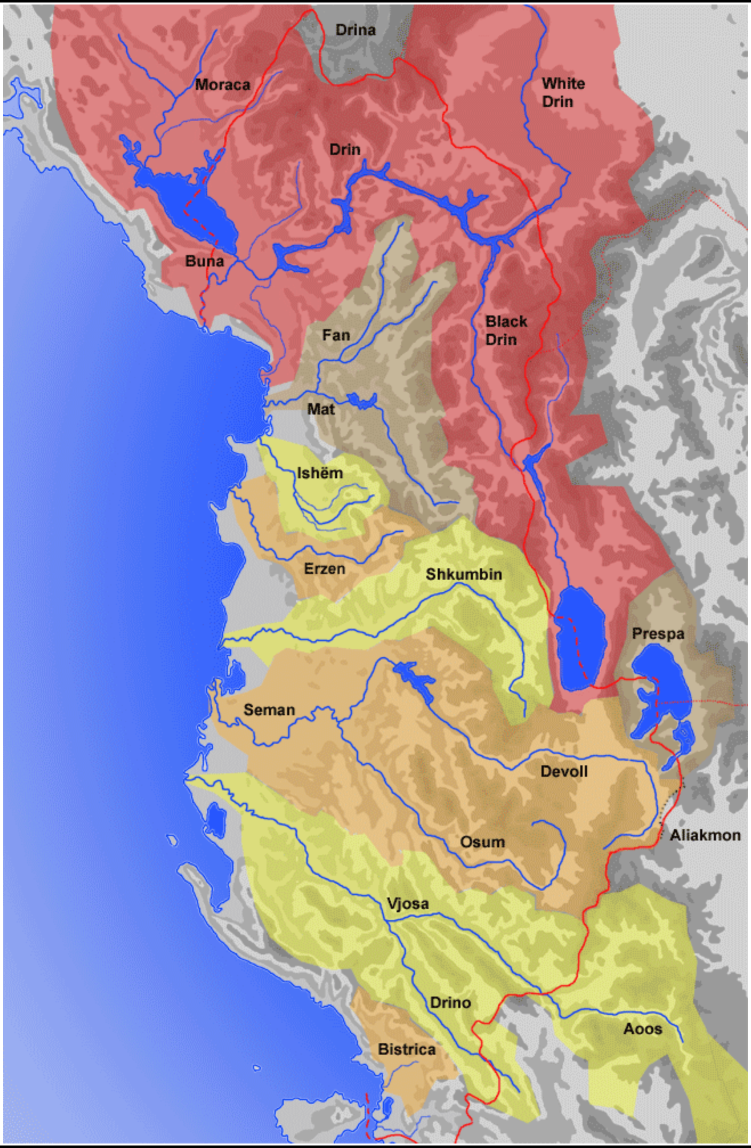
5.3.1. *Site Setting*

Waters represent a great resource for Albania.

The river network is quite complex, covering a hydrographic basin of about 43,305 km^2 (28,748 km^2 belonging to Albania Country). All rivers discharge in the Adriatic Sea and have generally East-West direction. The main rivers are Buna, Drini, Mati, Ishmi, Erzeni, Shkumbini, Semani and Vjosa (*Figure 5.3.1a*).

The available quantity of surface waters strongly decreases during summer months. Only 6-9% of the annual runoff is observed during the dry season (July – September).

Figure 5.3.1a Main Albanian Rivers and Catchments



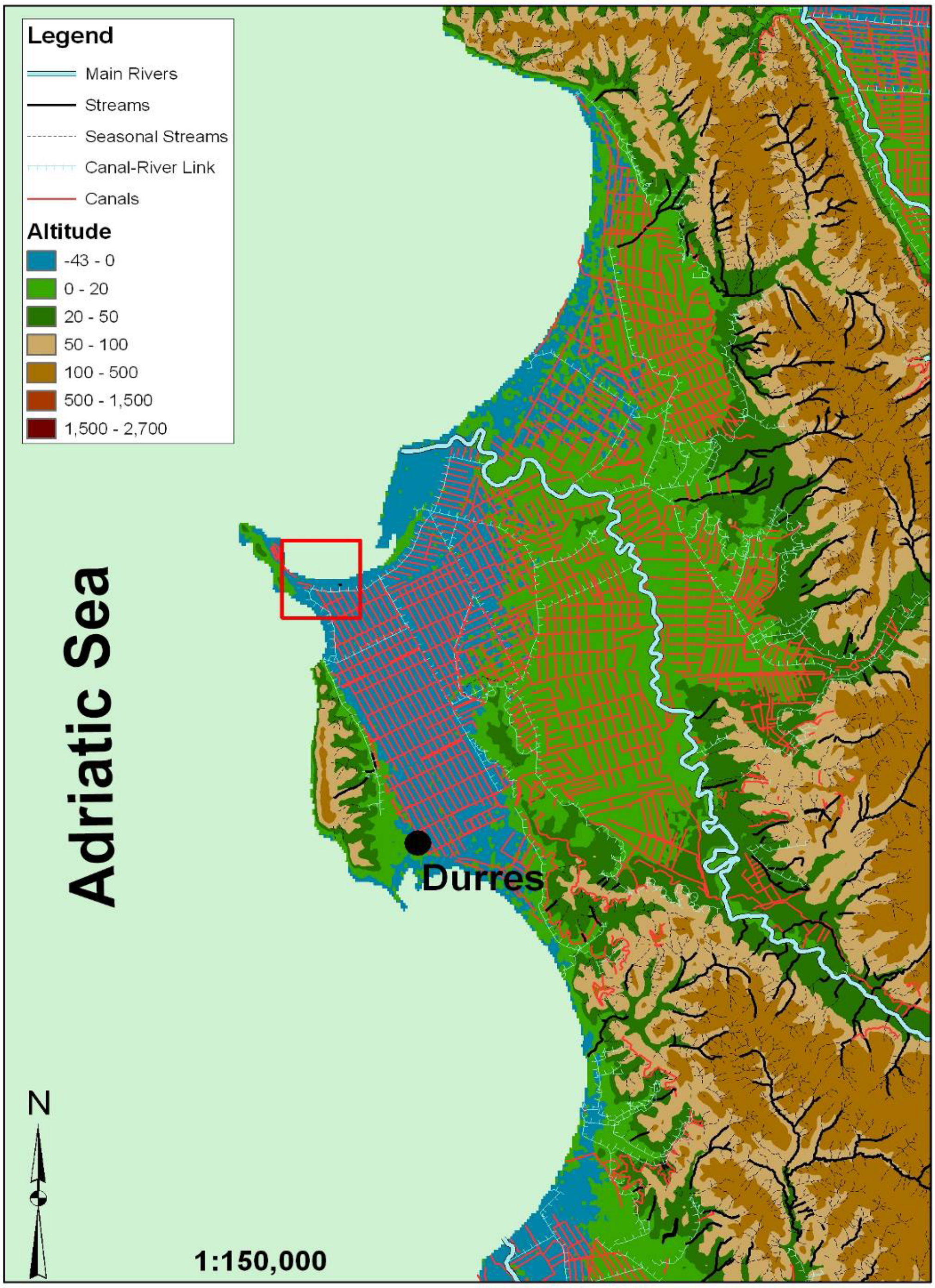
Albanian rivers are typical for their large volume. The general average annual flow is about 1,308 m^3/s, while solid flows are much higher. The average flow corresponds to a total volume of 53,250,000 ton of alluvial matter per year, equivalent to 1,650 kg/sec. The solid flow during the humid period of the year is 82% of the annual volume. The highest values of solid flows are recorded in the rivers Erzeni (5,635 g/m^3), Devolli (5,575 g/m^3) and Semani (4,367 g/m^3).

Durrës area has scarce water resources, both surface and groundwater. There is not any perennially flowing river in the area. The closest river is the Erzeni River, west of the site area. Since the elevation of this plain is low, its natural slope is not enough to create the flow to the Adriatic Sea. This caused the marshland before the construction of the drainage system of the Durrës plain. The drainage system represents the only surface water of the area. This open drainage system has been constructed for the reclamation of the former marsh in the Durrës Plain. The flow in the channels is driven by the pumping station located at the northernmost edge of Durrës Hills, in Porto Romano. The pumping station discharges the drained water into the Adriatic Sea. Should the pump station fail to operate, parts of the

Durrës plain would be flooded. Moreover, this system is connected with the nearby Erzeni River by a canal, loading river waters in the plain area south of the site. The Erzeni River represents the most important river in the area discharging its waters in the Lalzit Bay, located north of Porto Romano.

The complex surface water system is presented in *Figure 5.3.1b*.

Figure 5.3.1b Durrës Plain Hydrological Network



According to the results of many drilled wells, the conglomerate layers of Rrogozhina Formation are identified as the most important aquifer layers in the area of Durrës (*Figure 5.3.1c*).

Figura 5.3.1c Groundwater Settings in the Area of Durrës

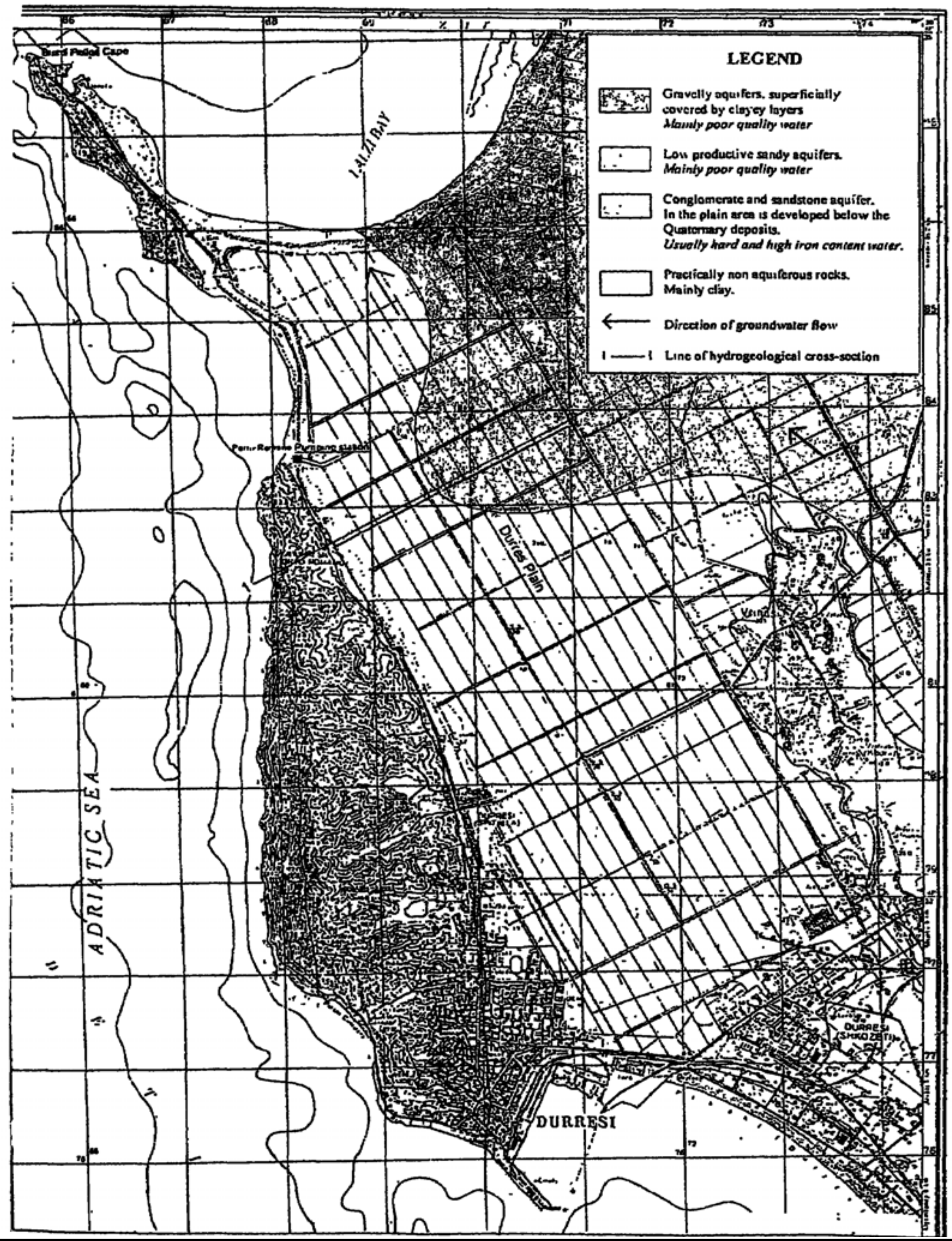
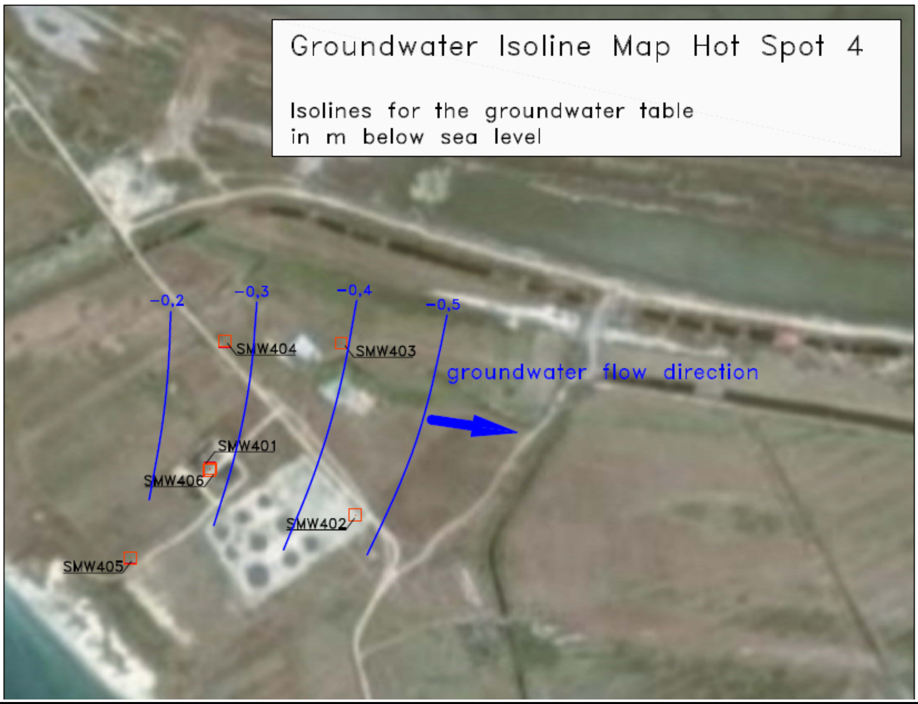


Figure 5.3.1c shows the direction of groundwater flow, which typically follows a NW direction in the area of Durrës .

Based on a survey carried out in 2007 close to the waste storage site in the north-western part of the Durrës Plain (close to the study area) the groundwater flow follows a SW direction as presented in *Figure 5.3.1d*.

Figure 5.3.1d Groundwater Flow Measured Close to the Study Area



In the past, particularly during the decades of the 80-90 of the last century, the former Hydrogeological Enterprise of Albania performed intensive hydrogeological investigations in the area of Spitalla plain. The aim of the investigations was to provide water as supply for the former Chemical Factory. Later on, some deep water wells were drilled in the northern part of the Spitalla plain, in order to supply the new industrial facilities which are under construction in the area.

As results from these investigations, the Spitalla plain appears to be an artesian basin, but at the same time it represents the most important hydrogeological component of the study area. There are two important aquifers identified in the Spitalla artesian basin: the conglomerate–sandstone aquifer and the gravely aquifer.

Main regional hydrogeological features of the wide Porto Romano area are shown in the hydrogeological map (*Figure 5.3.1e*).

It has to be highlighted that the clayey layer of the Quaternary deposits of Spitalla artesian basin assure a good isolation and protect the deeper conglomerate-sandstone aquifer from the potential infiltration of surface water pollution.

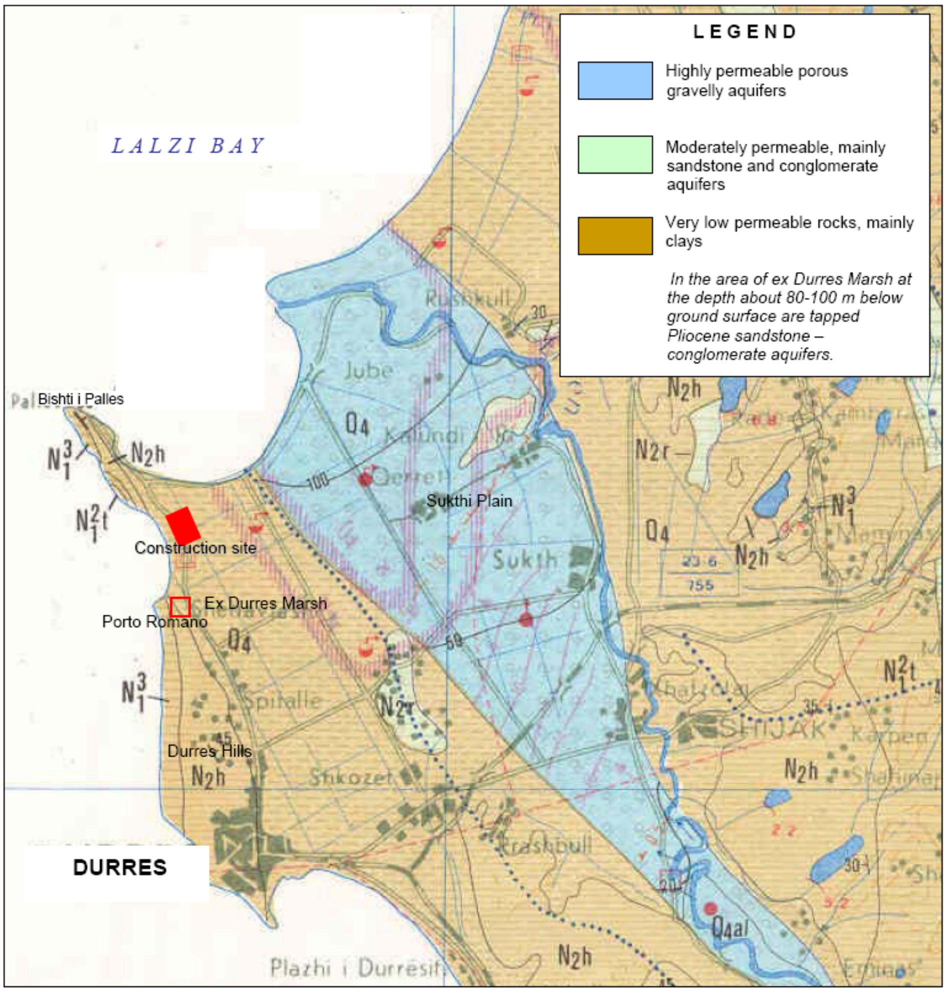
The main characteristics of the conglomerate-sandstone aquifer result as follows:

- Depth of wells: 160 -300 m;
- Depth of the top aquifer layer: usually more than 100 m;
- Piezometric level: about 1 to 2 m a.g.s.;
- Specific capacity of the wells: about 1 l/s/m;
- Permeability coefficient: about 2 to 3 m/day;
- Aquifer transmissibility: about 100 to 200 m^2/d;
- Capacity of well with submersible pumps: about 5 to 10 l/s'

Moreover, some thin deposits at hill slope contain small groundwater resources, having a particular connection with the life of local population.

These small groundwater resources are related also to the shallow Quaternary top soil deposits developed on the slopes of the Porto Romano hills. More than 30 shallow dug wells, with depths varying from about 5 to about 13 m, are dug on these deposits by the local population. Most of the wells become dry during summer period. The groundwater conductivity of the dug wells varies from about 500 µS/cm to more than 2000 µS/cm.

Figure 5.3.1e Hydrogeological Map of the Site



5.3.2. *Groundwater Quality*

The water quality of Rrogozhina formation aquifer is not satisfactory. The water quality of most of the artesian wells is within the limits of drinking water standards. The water is usually hard, the concentrations of chloride and sodium are in the limit of acceptability and the concentration of iron usually exceeds the limit of drinking water standard of 0.2 mg/l.

Since water quality is poor, the groundwater of Quaternary aquifer layers is not used for water supply purposes. The local population is using only the free flowing wells for their water supply.

During the September 2000 survey (UNEP) in a well water sample the following chemicals were measured: 4.4 mg/l of chlorobenzene (solubility in water: 500 mg/l), 60 µg/l of 1,3- and 1,4-dichlorbenzene (solubility in water: 120 mg/l and 70 mg/l), 7 µg/l of 1,2,3- and 1,2,4-trichlorobenzene (solubility in water: 30 mg/l) and 4 µg/l of HCH.

During the 2005 GKV survey, privately dug wells as well as three newly constructed monitoring wells were sampled to collect groundwater information at the Lindane/Dichromate Plant. Results indicate total HCH concentrations over the maximum allowable drinking water standard (MADWS for Lindane= 2 µg/l) in two private wells, having concentrations equal to 12.266 µg/l and 8.87 µg/l, and in all three hydrogeologic wells, with values equal to 47.22 µg/l, 7.07 µg/l and 9.08 µg/l. High values of Total Chromium were measured above drinking water standards (MADWS for total chromium = 50 µg/l): 28,300 µg/l, 145 µg/l and 200 µg/l. Total Chromium was also found to be high in a surface water sample (484 µg/l).

During the 2007 survey (ERM and SWS) the values of HCH and HCB exceeded the limits at Hot Spot 2 (Lindane Site). The location of the primary source could not be precisely identified and there is evidence that it stretches far beyond Hot Spot 2. In Hot Spot 3 the measured values of polluting material show a different picture. The section south of the river is most likely clean, the northern part only minimally polluted. The wider area Hot Spot 1 and 2 is polluted due to the tailings of Hot Spot 2. The most common contaminant is HCB, but HCH and Chromium(VI) are also present. At five sampling points strong contamination from HCH and HCB can be seen. The highest values of HCH are 171 µg/l and 377 µg/l.

The highest analyzed HCB contents were 40316 µg/l, 733 µ/l and 171 µg/l.

The water samples taken in the Dump Site and in the Waste Storage Site did not show any noticeable relevant value.

5.3.3. *Sea Water*

The Albanian coastal region contains two geographic entities: the Adriatic and the Ionian Sea coastal areas. The total length of the coastline is about 429 km. The continental shelf lies entirely within the exclusive zone. The shelf is wider in the north (Adriatic sea), up to 25 miles wide, and narrower in the south (Ionian sea), 2-3 miles wide. Beyond 25 miles, sea depth exceeds 1000 m in the international channel.

There are three types of rather low currents in the Adriatic sea: continuous currents, tidal currents and wind-driven currents. Strong winds persisting for a couple of days may create temporary currents running in the opposite direction with respect to steady and tidal currents.

The Adriatic coastal area (the northern part of the Albanian coast) is generally characterised by coastal lowlands (alluvial plains) intersected by rivers, and flanked by hills along its upland boundary. The coast is made of long sandy beaches, deltaic river mouths and lagoons. The coastal waters are shallow, receiving water from the rivers and several drainage canals. At the sea, the water depth increases slowly, starting from a sandy bottom, with the associated biocenosis, which becomes muddy as depth increases.

The site of interest is located in the upper part of Albania country belonging to the Adriatic Sea marine environment. A survey on the bathymetry near the site location has revealed that the -18 isobathymetric line is located 2 km far from the coast south of the site area and 800 m far from the coast north of the site (*Figure 5.3.3a).*

Figure 5.3.3a *Bathymetric Level, Durrës Area*

At the Porto Romano site, located below the latitude N 41° 23', current circulation is almost completely dependent on winds. During summer, mean surface currents are oriented to S due to the prevailing N winds; from October to April winds reverse and the currents flow is in the NNW direction. Current velocity are generally less than 0.02 m/s, though locally they may exceed 0.20 m/s due to the presence of eddies caused by the coastal reef system.

Sea Water Salinity in the investigated area varies from the value of 37 g/l in the southern part and increases progressively up to the value of 39 g/l. In Porto Romano, the average value is 38.2 g/l, with minor differences over the year: in winter the mean salinity is about 38.0 g/l while in summer it is about 38.34 g/l.

Maximum and minimum sea level measured in the last decade near Durrës are respectively 92 and -48 cm. In *Table 5.3.3a* mean monthly sea level is reported.

Table 5.3.3a Mean Sea Level (cm)

Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Mean Annual Level
15	14	11	9	9	10	9	10	12	16	19	17	12

Wave height less than 0.5 m has a 75% frequency. Source directions of waves having height greater than 0.5 are mainly SSW and SW (*Table 5.3.3b*).

Table 5.3.3b Frequency of Waves > 0.5 m (%) near Durrës

ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	Waves < 0.5 m
0.1	0.17	1.37	5.31	6.18	5.15	3.24	2.65	0.78	0.24	74.81

Mean annual temperature of the sea water is 17.8 °C (*Table 5.3.3c*).

Table 5.3.3c Mean Monthly Sea Water Temperature (°C)

Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Mean	Min	Max
12.0	11.8	13.1	15.8	19.2	21.9	23.0	23.4	22.8	19.9	16.7	13.8	17.8	7.9	28.0

The monthly average seawater temperature varies from about 12 °C in February to about 23 °C in July, August and September, but it is also important to highlight that the shallow water on the reef back is heated by the sun to about 1.5°C to 2.0°C higher than the deeper water.

Moreover there is no temperature stratification in the upper 20 m, because of the waves water mixing.

5.4. SOIL AND GROUNDWATER SITE AREA SURVEY

Environmental Resources Management (*ERM*) on behalf of Enel has undertaken Soil and Groundwater Investigations in the area intended for the Porto Romano Energy Project, in order to ascertain the environmental status of such area.

The activity was carried out in the presence and in strict cooperation with the Albanian Geological Survey Institute, represented by a senior field geologist.

In Annex 5.4 the Soil and Groundwater Site Area Survey Report is reported.

5.4.1. *Work Organization and Investigation Plan*

The following activities have been performed onsite:

- preliminary site walkover before starting the works in order to verify the presence of physical obstacles which could affect the final position of the boreholes;

- advance trial pits to a maximum depth of 2,5 m b.g.l. performed with backhoe excavator to collect soil samples following a 100x100 m grid;
- soil samples collection for each trial pit. Soil was sampled at two different depth levels. One sample was collected within the superficial layer (between 0 and 1 m b.g.l.), the second one was collected from the bottom (maximum depth 2,5 m);
- installation of 10 groundwater monitoring wells to a max depth of 10 m b.g.l. up- and down-groundwater gradient of the site;
- groundwater sampling from all the installed monitoring wells;
- physical-chemical groundwater parameters collection (pH, dissolved oxygen, conductibility, temperature and redox potential);
- 10 Top Soil samples collection (0-20 cm);
- analytical testing of soil and groundwater samples for the relevant compounds;
- Georeferencing by GPS system all investigated points (trial pits) and monitoring wells.

5.4.2. *Geology*

Based on field data, acquired during Trial Pit investigation (0.0 – 2.5 m.b.g.l.) and monitoring well investigation (0.0 – 10.0 m .g.l.), two different stratigraphic schemes have been identified:

- In the southern and north-western side of the area, starting from the ground level:
  - 0.0 - 0.5m: brown/grey lightly silty clay
  - 0.5 - 1.3/1.8m: silty clay, beige-green-grey, (plastic)
  - 1.3/1.8 – 10.0 m silty sand (containing organic matters and shells) and fine to medium sand, grey to dark grey, (containing organic matters, shells and with thin layers of peat);
- In the northern side of the area, from the top to the bottom:
  - 0.0 - 0.5m: brown sand, silty sand, clayey silt:
  - 0.5 – 1.5m: beige-white fine to medium sand with gravels, locally silty sand
  - 1.5 – 10.0m: fine grey to dark grey sand (containing organic matters, with thin layers of peat), suddenly with pebbles and gravels.

Groundwater was found, on average, from 2.0 to 2.2m.b.g.l.

5.4.3. *Hydrogeology*

According to the site investigation, the aquifer in the area is freatic and a general southeastward flow direction was determined.

The depth-to- groundwater levels, identified during field activities, are presented in the following *Table 5.4.3a*.

Table 5.4.3a *Depth – to - Groundwater Levels*

Monitoring Well	WT (m. a. or b.s.l.)	Measured Groundwater Level (m. below WT)[1]	Groundwater Level (m. a. or b.s.l.)	Measured Groundwater Level (m. below WT)	Groundwater Level (m. a. or b.s.l.)	Measured Groundwater Level (m. below WT)[1]	Groundwater Level (m. a. or b.s.l.)
		15/07/08 3.00 p.m.		17/07/08 9.00 a.m.		17/07/08 3.00 p.m.	
MW1	0.13	1.76	-1.630	1.77	-1.640	1.78	-1.650
MW2	0.171	1.72	-1.891	1.78	-1.951	1.77	-1.946
MW3	0.462	1.48	-1.942	1.52	-1.982	1.53	-1.992
MW4	0.243	1.49	-1.733	1.51	-1.758	1.52	-1.763
MW5	0.253	1.68	-1.427	1.69	-1.437	1.69	-1.437
MW6	0.285	1.18	-1.465	1.20	-1.485	1.20	-1.485
MW7	0.643	1.48	-2.123	1.49	-2.133	1.50	-2.148
MW8	0.337	1.30	-1.637	1.26	-1.597	1.31	-1.647
MW9	0.153	1.18	-1.333	1.19	-1.348	1.19	-1.348
MW10	0.809	1.88	-1.071	1.88	-1.071	1.88	-1.071

Remarks:
m a.s.l.: meter above sea level
m a. or b.s.l.: meter above or below sea level
WT: water well top,
[1]: measures taken from well head

Chemical and physical groundwater parameters were measured at each well during purging activities preliminary to sampling. The measured values are detailed in the *Table* below.

Table 5.4.3b *Field Measurements of Groundwater Chemical and Physical Parameters*

Monitoring Well	Dissolved O_2 (mg/l)	Conductivity (mS/cm)	pH	Temperature (°C)	Eh (mV)
MW1	0.33	80.7	6.89	18.7	-228
MW2	0.56	60.4	6.70	20.5	10
MW3	0.26	68.9	6.96	17.7	-313
MW4	0.22	58.5	7.13	18.3	-316
MW5	0.40	20.4	6.90	21.4	-121
MW6	0.40	13.5	7.40	18.2	-104
MW7	0.20	72.3	6.85	18.3	-73
MW8	0.30	25.1	7.40	19.5	-318
MW9	0.30	7.30	7.75	17.9	-65
MW10	0.25	16.0	7.20	20.0	-25
Sea Water	5.80	56.0	8.10	28.5	100

The groundwater beneath the site presents: low values of dissolved oxygen, ranging from 0.22 to 0.56 mg/l; neutral to slightly basic values of pH, ranging between 6.70 and 8.10; temperature ranging between 19 and 21 ^{o}C.

The groundwater conductivity in the northern side of the area (from 7 mS/cm to 25 mS/cm) presents lower values than the sea water conductivity (50 mS/cm). Higher values of conductivity, from about 58 mS/cm to 80 mS/cm, were noticed in the southern side of the area.

5.4.4. *Soil and Groundwater Quality*

No visual or olfactory evidence of contamination was noticed during the observations carried on the stratigraphic log.

No man made backfilling material was noticed in any of the 78 trial pits carried out.

No waste material was noticed on the ground surface.

Field observations during well purging revealed no visual or olfactory impact in all the monitoring points, but presence of clear water at all the stages of purging.

Analytical data for soil and groundwater were compared with the corresponding limit concentration values set forth in the Italian law (D.lgs. n. 152/06), which implements the applicable European Directives. The limit concentrations (CSCs – Contaminat Concentration Tresholds) for industrial land use were referenced to.

In general, the detected concentrations in the soil and groundwater samples collected in the area intended for the Porto Romano Energy Complex are below the analytical detection levels and/or below the corresponding CSCs. In some areas, limited exceedances of Fluorides, Sulphares, Iron and Manganese were detected in groundwater, which are attributable to the former status of natural salt marsh prior to land reclamation with a consequent groundwater enrichment in salt.

Significant concentrations of Iron and Manganese are present in all the groundwater samples and are probably due to the biological activity carried out by naturally occurring bacteria in the shallow aquifer.

The results of the soil and groundwater investigations carried out at the site show that the area is not affected by contamination caused by past human activity and that no remediation activities are needed prior to the construction of the proposed Energy Complex.

5.5. NOISE

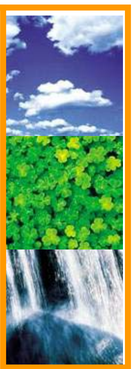
This *Paragraph* describes the existing noise levels in the investigated area. Vibrations have not been considered, since, due to the features of the specific project, such component is not relevant.

This *Paragraph* presents:

- a general description of the area, in which sound sources and receptors are located;
- noise limits in force in the area;
- results of the noise survey, carried out in July 2008 in order to establish the existing noise levels in the area;
- conclusions.

5.5.1. *General Description of the Area*

The investigated area is located on the wide coastal plain, in the north of Porto Romano. The area potentially impacted by the noise emissions of the *Power Plant* is within 1,000 metres from the fence.



The wide area presents different land uses: industrial, commercial, residential and agricultural. In the surroundings of the *Power Plant* there are some buildings:

- to the north west side, an inhabited house and a bathing establishment at 250 meter from the fence;
- to the north east side, some dwelling houses and a school at more than 1,000 meters;
- to the south side other inhabited houses (the nearest one, a building which lodges people at present working at the future customs house, is at 500 meters from the site).

No significant noise sources are present in the area; main sources are vehicles, wind, sea, birds and farm animals (cows, cock, sheep etc).

5.5.2. *Noise Limits*

Albanian legislation has not set limit values for noise in its territory. Therefore, in addition to the Albanian general *Law n. 9774 of 12 December 2007,* also some international guidelines have been taken into account. In particular, the EIA Report considers, as limit values, those fixed by World Health Organization in the document *"General EHS - Environmental, Health, and Safety - Guidelines"*, as reported in the following *Table*.

Table 5.5.2a *Noise Level Guidelines*

Receptor	One Hour LAeq (dB(A))	
	Day time (07.00 – 22.00)	Night time (22.00 – 07.00)
Residential; institutional; educational	55	45
Industrial; commercial	70	70

Sources: Guidelines for Community Noise, World Health Organization - WHO, 1999

Moreover, according to the guidelines, environmental noise immissions (all sources) at receptors should not exceed residual noise (no plant emission) of more than 3 dB.

5.5.3. *Measurements*

A noise survey has been carried out by Enel on 7, 8, 9 and 10 July 2008, in order to establish existing noise levels in the area. Noise levels have been measured in seven points located near the receptors closest to the *site*, either during day period or night period.

In each point 3 measures during day period and 2 measure during night day period, 15-25 minutes long, have been carried out. In point P6, being a school, only 3 measures during day period have been carried out.

The instrument used during the survey has the following features:

- precision phonometer Larson Davis 824; according to standard IEC651 type 1 and IEC 804 type 1;
- microphone ½" free field type 2541;

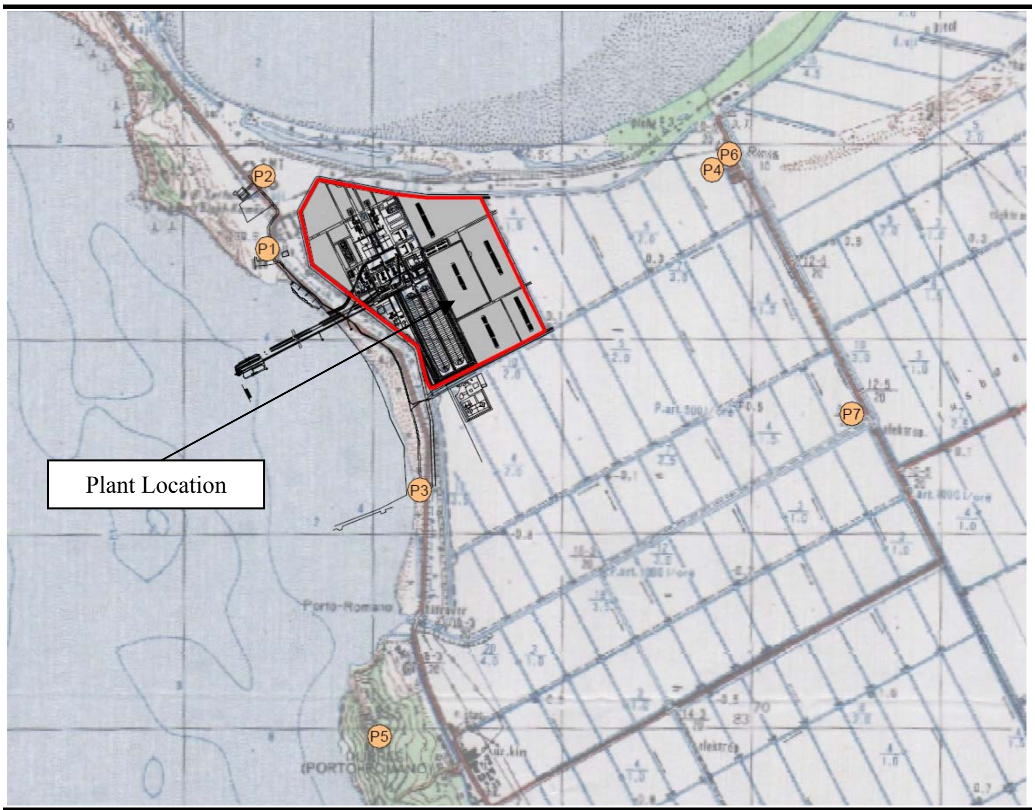
- noise level calibrator CAL 2000 according IEC 942 class 1;
- software N&V Works for LD824.

Reference points, marked as P1-P7, are shown in *Figure 5.5.3a* and presented in the next *Table*.

Table 5.5.3a Noise Monitoring Locations

Measurement point	Description
P1	Bathing establishment, 1 floor
P2	Inhabited house, 1 floor
P3	Future customs house, 4 floors
P4	Inhabited houses, 1-2 floors
P5	Inhabited houses, 1 floor
P6	School, 2 floors
P7	Inhabited houses, 1 floor

Figure 5.5.3a Noise Monitoring Locations



Five of the seven identified monitoring points (P2 and from P4 to P7) are close to residential, institutional, educational receptors; therefore they have a limit value of 55 dB during day time and 45 dB during night time. Moreover, P6 is a school, therefore it has to comply only with day limits.

Only points P1 and P3 are near an industrial-commercial receptor, having therefore a limit value of 70 dB both during night and day time.

5.5.4. *Results*

Tables 5.5.4a and *5.5.4b* present the main findings of the survey, respectively for day period and night period. The *Tables* present monitoring points, day, hour and duration of the measurement, measured equivalent level (Leq) and some notes on noise sources.

Figure 5.5.4a shows some photos of the monitoring points; *Annex 5.5.4a* presents, for each point, parameters, statistical levels and frequency analysis.

Figure 5.5.4a *Photos of Monitoring Points*

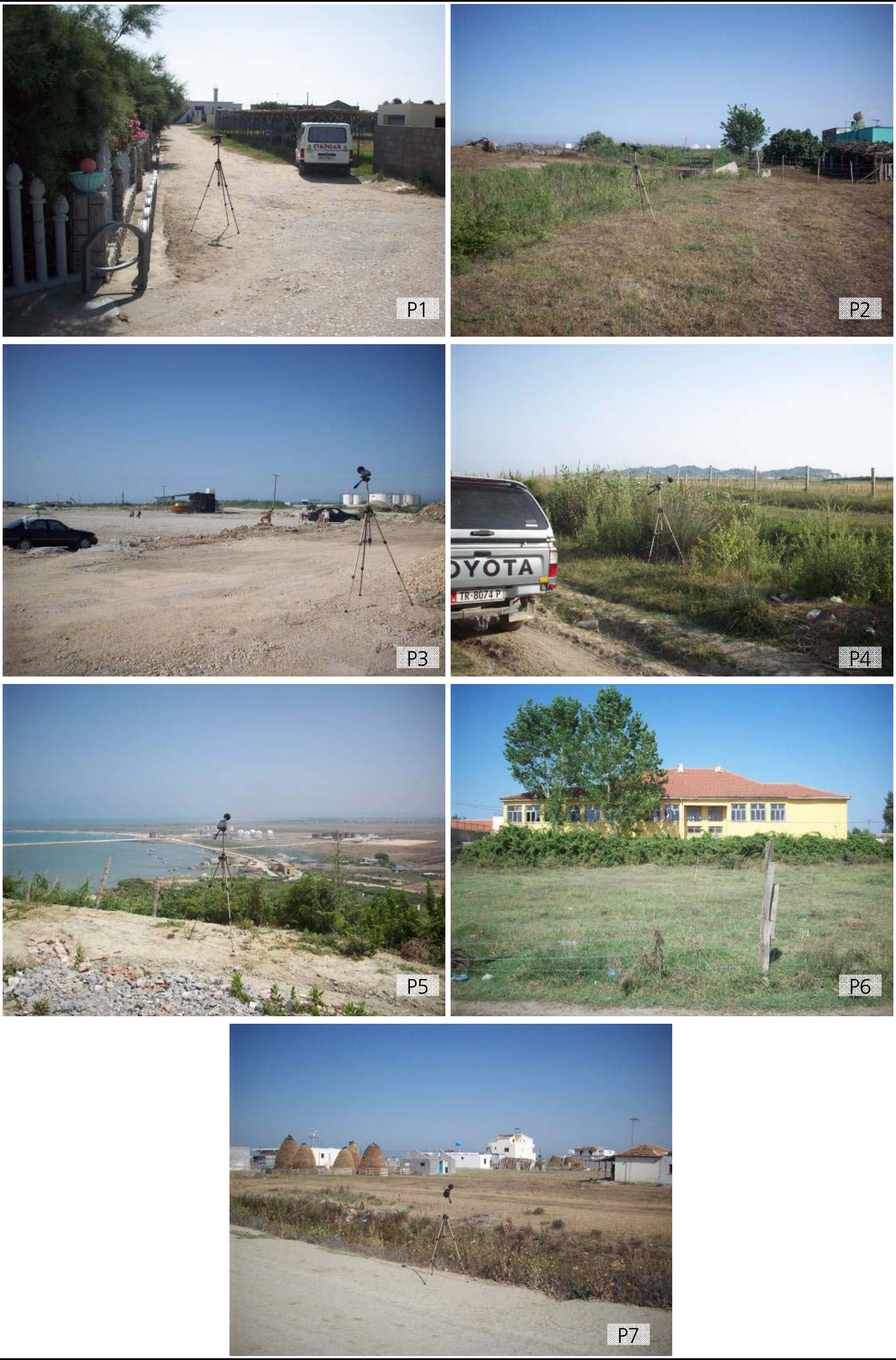


Table 5.5.4a Results of Noise Survey during Day Period

Point	Day	Hour	Duration (min.)	Sound sources	Leq dB(A)
P1/1	07/07/08	16.10	23	Crickets, birds, sea, children, voices in bathing establishment, vehicles in transit (6)	57,2
P1/2	08/07/08	10.07	20	Crickets, sea, vehicles in transit (3)	54,7
P1/3	10/07/08	14.35	20	Crickets, cicadas, cock, sea, children voices and voices in bathing establishment	48,6
P2/1	07/07/08	16.41	20	Crickets, cock, cows, birds, grasshoppers, sea, works near grey silos	51,6
P2/2	08/07/08	9.32	20	Cows, crickets, dog, noise from houses (voices), vehicles in transit (1)	48,8
P2/3	10/07/08	15.02	28	Crickets, birds, hens, wind	53,2
P3/1	07/07/08	17.15	20	Sea, children, road yard	50,6
P3/2	08/07/08	10.37	22	Sea, bathers, vehicles in transit (1)	56,2
P3/3	09/07/08	15.39	20	Wind, sea, children voices, noise from firm GAS, vehicles in transit (3)	61,6
P4/1	07/07/08	18.00	20	Crickets, leaves moved by wind	48,6
P4/2	08/07/08	12.35	20	Crickets, wind, leaves moved by wind	48,6
P4/3	08/07/08	15.25	20	Crickets, wind, leaves moved by wind	50,9
P5/1	08/07/08	11.29	20	Cows, crickets, traffic from road, wind	63,7
P5/2	08/07/08	17.04	20	Crickets, goats, cows, children	66,5
P5/3	09/07/08	15.01	25	Crickets, wind, work near pier, children	60,6
P6/1	08/07/08	12.10	20	Crickets, voices, vehicles in transit (3)	55,0
P6/2	08/07/08	15.52	20	Crickets, cocks voices from houses	55,2
P6/3	10/07/08	15.50	20	Cicadas, leaves moved by wind, noise from road, voices	55,1
P7/1	08/07/08	16.24	20	Crickets, wind	51,0
P7/2	09/07/08	8.59	20	Crickets, horn, voices from houses, vehicles in transit (2)	48,6
P7/3	10/07/08	16.18	20	Cicadas, wind	57,1

Table 5.5.4b Results of Noise Survey during Night Period

Point	Day	Hour	Duration (min.)	Sound sources	Leq dB(A)
P1/1	10/07/08	1.13	15	Crickets, dog, sea, voices	48,0
P1/2	10/07/08	4.08	15	Crickets, dogs, sea	41,8
P2/1	10/07/08	0.51	15	Cows, crickets	46,4
P2/2	10/07/08	3.47	15	Crickets	43,5
P3/1	10/07/08	1.40	15	Crickets, dogs, sea	55,7
P3/2	10/07/08	4.33	15	Crickets, dogs, birds, sea	57,2
P4/1	10/07/08	0.15	15	Crickets, dogs	42,8
P4/2	10/07/08	3.12	15	Crickets, dogs	40,4
P5/1	09/07/08	22.48	15	Crickets, dogs	47,9
P5/2	10/07/08	2.11	15	Crickets, dogs, sea	45,9
P7/1	09/07/08	23.27	26	Crickets, dog	58,9
P7/2	10/07/08	2.47	15	Crickets, dogs	46,8

During day period, Leq values at the monitoring points vary from a minimum of 48,6 dB(A), in point P4, to a maximum of 66,5 dB(A), in point P5. During night period, Leq values vary from 40,4 dB(A), in point P4, to 58,9 dB(A), in point P7.

Table 5.5.4c presents the main results of the noise survey, showing average values during day and night period in each point, compared to limit values in force in each point.

Table 5.5.4c Comparison between Measured Day and Night Values and Limit Values in Force

Point	Day period		Night period	
	Leq (dBA)	Limit value (dBA)	Leq (dBA)	Limit value (dBA)
P1	54,7	70	45,9	70
P2	51,6	55	45,2	45
P3	58,2	70	56,5	70
P4	49,5	55	41,8	45
P5	64,2	55	47,0	45
P6	55,1	55	-	not applicable
P7	53,7	55	56,1	45

During day period, the highest Leq value has been recorded in point P5 (64,2 dB(A)), while the lowest value has been recorded in point P4 (49,5 dB(A)). During night period, instead, the highest and the lowest values have been recorded respectively in point P7 (56,1 dB(A)) and in point P4 (41,8 dB(A)).

The recorded levels of noise exceeded the limit value in points P5 and P6 during day time (due mainly to natural noise and kids voices) and in points P2, P5 and P7 during night time (due mainly to natural noise).

5.5.5. *Conclusions*

In the investigated area measured noise levels are most of all lower than limit values fixed by law in force.

Values exceeding limits are mainly due to natural noise (wind, sea, birds and farm animals), few vehicles in transit and voices.

5.6. VEGETATION, FLORA, FAUNA AND ECOSYSTEMS

The study area is located in Porto Romano near Durrës . The vegetation and fauna have been studied within 5km from the site area (*Figure 5.6.1.3a*).

The area is mainly characterized by sandy shores salt marsh land, grassland, cultivated land and orchards.

5.6.1. *Vegetation and Flora*

5.6.1.1. *Methodology*

Flora and vegetation have been studied through the following:

- bibliographical research on flora and vegetation in the Study Area and in the South of Albania;
- analysis of aerial and satellite imagines of the area;
- record of flora;
- drawing vegetation and habitat maps and reporting.

Field investigations were performed in July 2008, from the 7th to the 11th. The vegetation of the area was investigated through the analysis of the main species of flora covering homogenous vegetation areas. Also the distribution of different flora species was characterized.

5.6.1.2. *Potential Vegetation*

The study area is inside the Illyrian deciduous forests ecoregion, which is extended all along the coastal ranges of the Eastern Adriatic coast, from the eastern Alps to the northern Ionian coast between Albania and Greece.

The ecoregion is characterized by an average annual rainfall of 1,500-2,000 mm, which can locally exceed 3,000 mm. January average temperatures are below freezing (from -10 ° C to 0 ° C). Average temperatures in July are between 15 to 20 ° C.

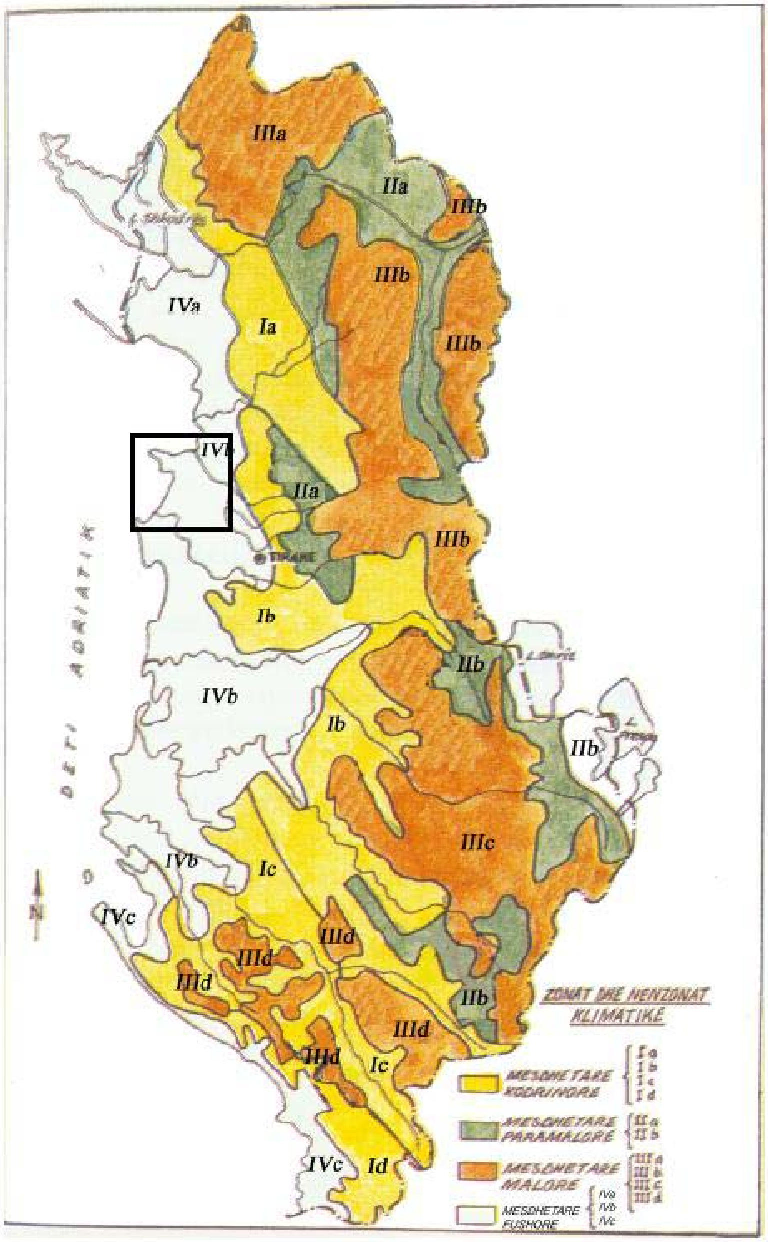
The wide altitudinal range of this ecoregion results in two major forest zones: a conifer zone, occurring at the highest elevations (average altitudinal range of 1,200-2,500 m), and a mixed broadleaf zone, covering medium elevations and lowlands.

Broadleaf beech and mixed oak forests dominate at medium and lower altitudes in deep soil and humid elevations, valleys and canyons. A remarkably high diversity of deciduous oak species (*Quercus frainetto, Q. pubescens, Q. cerris, Q. virgiliana, Q. dalechampii*) and other deciduous broadleaf species (*Carpinus orientalis, Castanea sativa, Ostrya carpinifolia, Tilia spp., Sorbus spp., Acer spp.*) characterize the coastal slopes. Evergreen trees, mainly holm oak (*Quercus ilex*) and Aleppo pine (*Pinus halepensis*), and maquis shrubs (*Pistacia terebinthus, Rhamnus alaternus, Phillyrea latifolia, Arbutus unedo*) become predominant at the lower altitudes near the coast (*www.worldwildlife.org*).

The study area is sited within the Mediterranean plane zone (central sub zone). The yearly mean temperature is 15°C and the lowest yearly temperatures recorded are between 6,5°C and 7,5°C. The annual rainfall is about 1,500 – 1,700 mm.

The climatic expected vegetation is the Mediterranean scrub and holm oaks forest belongs to the order *Quercetalia ilicis*.

Figure 5.6.1.2a *Climatic Map (The study area is located within the black rectangle)*



Source: VAngjeli et al. 1997 (from: C. Colacino)

5.6.1.3. *Vegetation of the Area*

The plant communities investigated in the area belong mainly to salt marsh land, rural habitat, sandy areas and Mediterranean scrub.

The vegetation of the area is strictly influenced both by the presence of salt groundwater, whose level grows to the top of the soil during winter season, and by human activities (e.g. livestock grazing).

The vegetation communities recorded in the study area are listed in *Table 5.6.1.3a* and mapped in *Figure 5.6.1.3a*.

Table 5.6.1.3a Vegetation Communities

Vegetation Community	Features
Mediterranean shrub	*Spartium junceum* with *Ulmus minor* scrubs
Woods	*Pinus pinea*
Seminatural Grassland (Untilled land/Grassland)	*Dictrichia viscose*
Tilled	Wheat, corn, etc.
Salt marsh land	*Salicornia europea*
Inland water	*Phragmites australis*, *Thypa latifolia* and *Arundo donax*
Sandy shores	*Cakilo-Xanthietum italici*
Sea	*Posidonia ocenica*
Residential areas	-

Mediterranean Shrub

The Mediterranean shrub formation found within the study area is located in the little area within the peninsula and the great part of this formation grows on military area where the access is forbidden.

Outside the military area the mediteranean shrub formation presents mainly *Spartium junceum* which is linked with *Ulmus minor*, *Arbutus unendo*, *Pistacia lentiscus, Cistus incanus* and *Phyllirea latifolia*. The presence of *Ulmus minor* is unusual.

Figure 5.6.1.3b Spartium Junceum and Ulmus Minor

Woods

The woods formation is located near the shoreline in the north east of study area and it is due to a forestation with *Pinus pinea*. *Palinurus spina christi, Rubus hulmifolius, Dittrichia viscose* and *Spatium junceum* grow under *Pinus pinea*. This area is affected by livestock grazing which restricts vegetation growth.

The pine forest is parallel with the shoreline. These forests were cultivated (30-40 years ago) in order to stabilize the sandy dunes and protect the agricultural lands.

Figure 5.6.1.3c Pinus Pinea Woods

Seminatural Grassland

Semi-natural grasslands are formed as a result of the combined effects of natural processes and anthropogenic activities. Land-use processes such as grazing or mowing are shown to influence species richness. The untilled areas, at the moment, are included within this category.

Within the study area two kinds of grassland could be identified in relation to the influence of the salt ground water. The vegetation of the lowered area is generally characterized by the presence of flora which normally grows in the salt marsh land, such as *Juncus acutus*, *Salicornia europea*, *Limonium vulgare, Hardeum marinum* and *Halimione portulacoides, while* the grassland of the other area is generally characterized by *Dittrichia viscosa, Scalymus hispanicus, Phenicula vulgaris, Daucus carata, Eryngium spp., Linaria spp., Trifolium campestris, Avena sterilis, Hardeum murinum, Cynosurus echinatus, Achantus spp., Pteridium aquilinum, Rubus hulmifolius.*

Figure 5.6.1.3d   Dittrichia Viscosa and Rubus Hulmifolius

Tilled Land/Orchards

Wheat is the main crop. Corn, oats, sorghum, vine, vegetables, sunflowers and fruits are also cultivated. There are olive and citrus plantation among orchards. All these cultivations are associated with weeds and with the same species of the seminatural grassland.

Salt Marsh Land

Salt marshes and their associated plant communities are found along the coastline from Porto Romano peninsula to Erzeni river mouth and on the bottom of the irrigation canals where there is a superficial salt groundwater (just beside the road that runs along the shoreline from the pumping station to the base of the peninsula).

Salt marshes are component of sequences of plant communities tolerant of different degrees of submergence by the tide. Species composition of these plant communities is relatively simple with only a few species able to tolerate the stressful conditions. The main species, which occur in these zone, such as *Salicornia spp.*, *Arthrocnemum spp.*, *Salsola soda*, *Limonium spp.*, are often present in mono specific stands. However, as the number of tides covering the marshes is reduced as its height increases, the species composition becomes increasingly complex and more variable.

The distribution of the plant communities does not follow a linear scheme such as in sandy dunes vegetation. The plant communities of the classes *Thero- Salicornietea* and *Juncetea maritimi* cover a large surface; the predominant species are *Arthrocnemum fruticosum*, *A. perenne*, *A. glaucum*, *Salicornia europea*, *Salsola soda*, *Juncus acutus*, *Juncus maritimus*, *Inula crithmoides*, *Limonium vulgare* and *Halimione portucaloides*.

Figure 5.6.1.3e Salicornia

Inland Water

This vegetation type is spread mainly along the irrigation channels. The main species of the hydro - hygrophilic vegetation are *Phragmites australis*, *Typha angustifolia* and *T. latifolia*. *Populus albae* and *Salix spp* are less frequent.

The communities dominated by *Phragmites australis* are characterized by a wider ecological amplitude in the direction of the salt scale. Their distribution is fragmental and often without any visible role in the general plant physiognomy of the natural ecosystem of the area. The plant communities dominated by the species mentioned above are: *Phragmitetum communis*, *Typhetum angustifoliae* and *Typhetum latifoliae* and belong to the class *Phragmitetea* and *Salicetea purpureae*.

Figure 5.6.1.3f Phragmites Australis

Sandy Shores

The sandy belt along the coastline is completely bare of vegetation to a length sometimes extending up to 30 m.

The species which grow in the first belt near the sea are pioneer and are the following: *Cakile maritima*, *Xanthium strumarium* subsp. *italicum*, *Salsola kali*. The vegetation of this sandy belt belongs to the pioneer association *Cakilo-Xanthietum italici*.

Gradually going away from the coastline and as the sandy dunes increase, the physiognomy of vegetation is imparted by the species *Ammophila arenaria* subsp *arundinaceae*, *Elymus farctus*, *Echinophora spinosa* etc. On sand dunes, these species are important dune building plants (association *Ammophiletum*).

The *Schoeno- Erianthetum* association, dominated by *Erianthus ravennae,* and *Vitici-Tamaricetum dalmaticae,* dominated by *Tamarix dalmatica,* also occur on sandy shorelines and at the edge of the areas dominated by *Juncus spp*.. This association is typically between salt land and not salt land communities. There are also few specimens of *Juniperus spp.*.

The sandy shorelines vegetation is directly impacted by human activities (e.g. recreation, excavation, etc.).

Figure 5.6.1.3g Cakile Maritima and Xanthium Strumarium

Sea

Few meters from the shoreline, around Porto Romano's peninsula, there is a meadow of *Posidonia oceanica*. The presence of *P. oceanica* can be worked out from the shares of the plant on the seashore.

The distribution of *P.ocenica* was studied by Geosat, for Enel, through divers who took note on the plant presence in 185 sampling points (vertices of the sampling grid). The distribution map of *Posidonia oceanica* is presented in *Figure 5.6.1.3h*.

Posidona oceanica does not constitute an uninterrupted meadow but it forms several patches with different sizes. The status of the *P. ocenica* was assessed by divers' observations along two transects: shoot density was sampled (number of shoots/m^2). The *P.ocenica* associations along the transects are characterized by long leaves and high shoots density less then 300 shoots/m^2. According to Giraud classification (*Table 5.6.1.3b*, Giraud 1997 from APAT 2004) these *P.ocenica* patches belong to Class IV.

Table 5.6.1.3b *Classification of* Posidonia ocenica *meadows with regard to shoot density*

Class	Shoot number	Density Evaluation
I	> 700 shoots/m^2	High Density Meadow
II	400< shoots/m^2<700	Density Meadow
III	300< shoots/m^2<400	Sparse Meadow
IV	150< shoots/m^2<300	Very Sparse Meadow
V	50< shoots/m^2<150	Semi-Meadow

However other studies (Republic of Albania - Ministry of the Territory Adjustment and Tourism "*Integrated Water and Ecosystems Management Project*"- September, 2003) report a regression of *Posidonia oceanica* meadows in the Porto Romano area. This regression is due to the polluted industrial and urban discharges, which cause an increase in water turbidity (Secchi disc. 1.25-1.50 m), and to the light exposure reduction on the sea bed, which caused a regression of Posidonia oceanica meadows over the last decades (Kashta L., 1998).

Sparse Cymodocea nodosa was also was observed during the marine survey. Cymodocea nodosa as P.ocenica is a marine phanerogam but this specie lives on sandy sea bottom with high lightness.

In the Porto Romano bay, also the development of some nitrofile algae populations (*Ulva rigida* and *Enteromorpha* spp.) was assessed. This is another demonstration of eutrophication in these waters. Ammonia can be converted to organic nitrogen by these resident algae (*Ulva*, *Enteromorpha*). *Ulva* blooms can become so abnormal that the algal decay products are more unpleasant than the sewage wastewater itself.

Figure 5.6.1.3i Posidonia oceanica *Meadow*

Figure 5.6.1.3 *Pelote de Mer (from* Posidonia oceanica*)*

Residential Areas

The residential areas are little and in their surroundings there is the same kind of vegetation as in the seminatural grassland, with tree species such as *Eucalyptus spp.*.

5.6.1.4. *Conclusion*

The area of Porto Romano bay is a narrow, reclaimed part of the coastal plain. There are some natural habitats left along the coastline, such as a belt of pine trees, temporary marshes and salt marshes. In addition to the loss of large wetland parts due to land reclamation, the quality of the natural environment in the area continues to deteriorate due to the increase of human activities such as direct discharge of untreated urban and industrial wastewater in the Porto Romano bay, excessive felling of trees for fuel, excessive erosion phenomena, grazing, removal of natural vegetation, etc.

The most sensitive specie of the area is *Posidonia oceanica* (protected by *92/43/CEE Directive*) which is in regression in all the Adriatic area. Sandy shorelines vegetation is also endangered because of the human pressure (e.g soil removal for recreation activities).

5.6.2. *Fauna and Ecosystems*

5.6.2.1. *Methodology*

Fauna and ecosystems have been studied through the following:

- bibliographical research on fauna and habitats in the Study Area and surrounding areas;
- survey to verify the bibliographic data;
- analysis of the areas important for fauna;
- study of the fauna in relation to the habitat;
- characterization of endangered species;
- reporting.

The presence/absence of species was evaluated in relation to the habitat presence in the study area and in the surroundings. Field investigations were performed in July 2008, from the 7th to the 11th.

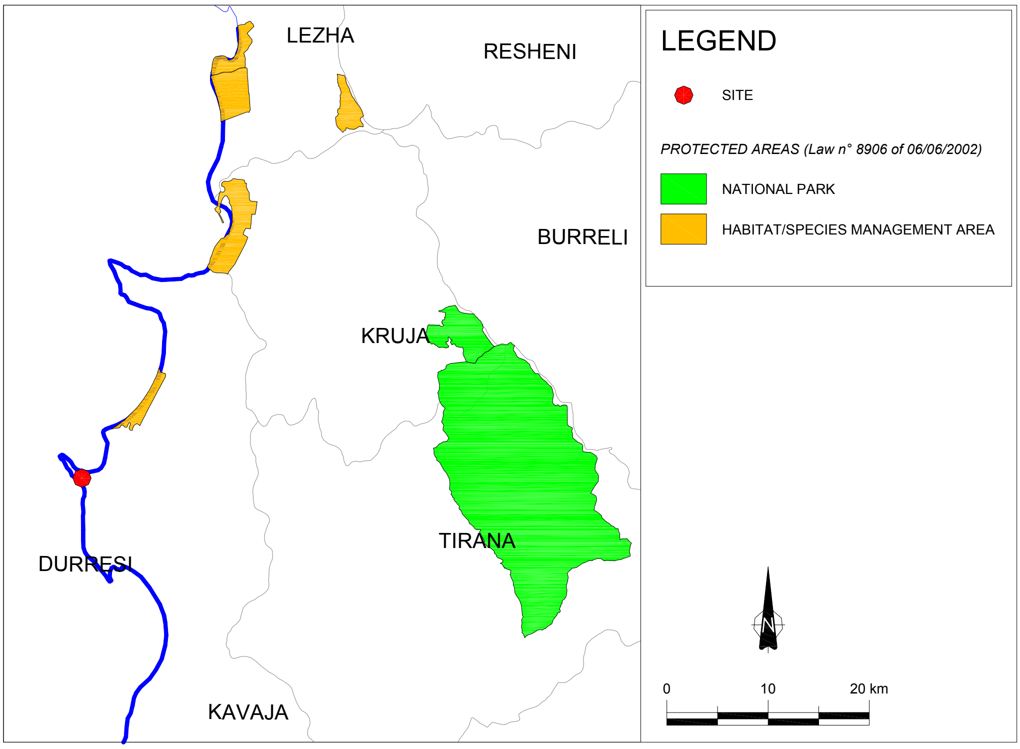
The study was carried out only for the vertebrates fauna used as indicator for the biocenosis value. The importance of the species was evaluated in relation to their belonging to:

- IUCN Red List Categories;
- Annex I European Directive 79/409;
- Annex II European Directive 92/43.

5.6.2.2. *Protected Areas or Conservation Hotspots*

No protected area or conservation hotspost is inside the study area. The nearest protected area is Rrushkull wetland a "Managed Nature Reserve" (law n°8906 06/06/2002) which is about 7 km from the site, just above the Erzen river mouth.

Figure 5.6.2.2a Map of Albanian Protected Areas – The Study Area is Located Within Red Square



Rrushkull Wetland

The area of Rrushkull-Erzeni River outlet originates from the alluvial sediments of the Erzeni river, which meanders across the area. The protected area lays in the Lalzi bay, from the Erzeni river mouth to the South and the overflow of the Tarini stream to the North. At East the protected area is bordered by agricultural land.

The Rrushkull wetland is also classified among the European Important Birds Area (IBA), because over 10,000 water birds and wetland birds have been counted within the area. The area is characterized by several habitats such as:

- alluvial Mediterranean forest of Alnus glutinosa, Ulmus campestris and Fraxinus angustifolia;
- sand dunes relatively well developed;
- halo-phyte and hygro-phyte vegetation (wetland, marshland);
- a planted pine forest.

The belt of sand dunes is from 10 to 50 m wide and is along the entire coastline. The sand dune vegetation is characterized by *Cakile maritima* plant association, which grows in isolated spots 4-5 m far from each other, closer to the shoreline, and by *Elymus farctus* plant association, which grows in the well developed dunes. Other species which belong to this association are *Eryngium maritimum*, *Echinophora spinosa* and *Euphorbia paralias*.

Salt tolerant vegetation is characterized by the following species: *Arthrocnemum fruticosum*, *A. perenne*, *Salicornia europaea*, *Halimione portulacoides*, *Limonium vulgare*, *Inula crithmoides* etc.

The most abundant tree species are *Pinus pinaster* and *P. halepensis* whose formation is generally not so dense. There are other tree formations in the area, which contain also some rare and endangered plant species such as: *Quercus robur*, *Fraxinus excelsior*, *Juniperus oxycedrus*, *Matthiola tricuspidata*, *Pancriatium maritimum*, *Quercus ilex*, *Adiantium capillus-veneris*, *Butomus umbellatus*, *Salix triandra*.

The area is also an important fishing site. Among fish there are: *Mugil spp*., *Liza spp*., *Dicentrachus labrax*, *Umbrina. cirrosa*, *Lichia amia*, *Sparus spp*., *Alosa phalax*, *Anguila anguila*, among crustaceans *Paeneus ceraturus* and among bivalves *Venus galina* and *Donax trunculus*.

The area is especially important for wintering waders and dabbling ducks. Among them is worth mentioning the presence of Golden Plover (*Pluvialis squatarola*), European Curlew (*Numenius arquata*), Little Stint (*Calidris alpine*), Wigeon (*Anas Penelope*), Teal (*Anas crecca*), ferruginous duck (*Aythya nyroca*), pygmy cormorant (*Phalacrocorax pygmaeus*) and pallid harrier (*Circus macrourus*).

Among mammals the most important species which live within the area are the mouse ear bat (*Myotis myotis*) and the otter (*Lutra lutra*).

5.6.2.3. *Habitats in the Area*

The habitats identified in the study area are taken from the vegetation map. The endangered level of habitats was assessed through their belonging to Annex I of European Directive 92/43 and to the list of species and habitat endangered in Albania (*B.Ruci et al*.)

The following habitats have been identified in the study area:

- Mediterranean Scrub;
- Pine Wood;
- Salt Marsh Land;
- Sandy Shorelines;
- Seminatural grassland;
- Inland Water;
- Tilled land;
- Sea.

The location of these habitats is presented in *Figure 5.6.1.3a*.

Table 5.6.2.3a Habitat in the Study Area

Habitat/Vegetation	Features	European Directive 92/43	Albanian Endangered Habitat
Mediterranean Scrub	*Spartium junceum*	-	-
Pine Wood	Forestation with *Pinus pinea*	Cod. 9540	-
Salt Marsh Land	class *Thero-Salicornietea* and *Juncetea maritimi*	Cod. 1310 Cod. 1410 Cod 1420	-
Sandy Shorelines	*Cakilo-Xanthietum italici* association *Ammophiletum* association *Schoeno- Erianthetum* association *Tamarix dalmatica*	Cod. 1640	-
Seminatural grassland	dry grass land	-	-
Inland Water	*Phragmitetum communis*	-	-
Tilled land	-	-	-
Sea	*Posidonia oceanica* meadows	1120* (priority habitat)	*Posidonion oceanicae* (Vulnerable)

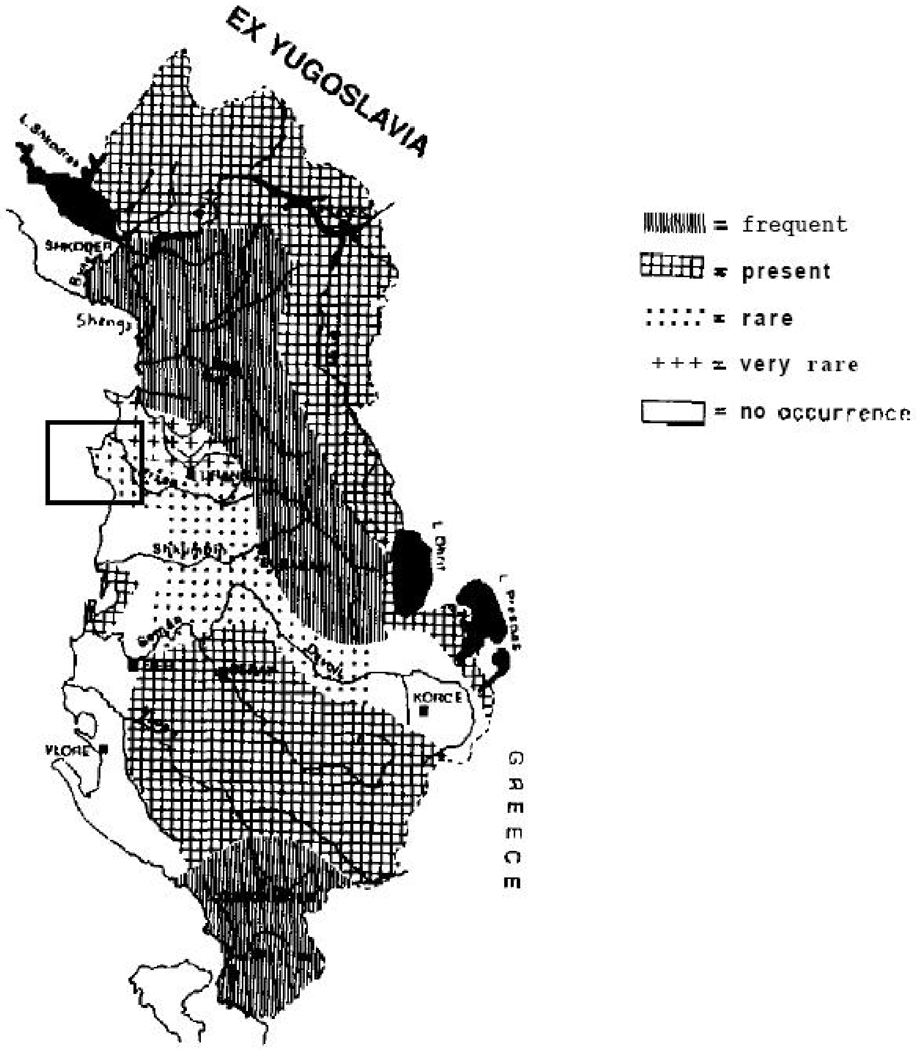
The *Posidonia oceanica* is the only habitat within the study area included both in the vulnerable habitats of Albania (*B. Ruci et al.*) and in the European priority habitats (habitats which need particular protection actions).

5.6.2.4. *Fauna in the Area*

The habitats in the study area were modified by human activities, mainly land reclamation, which caused the loss of a big part of the wetland area. The remaining natural habitats are along the coastline, such as a belt of pine trees, temporary marshes and salt marshes. The remaining habitats can support mainly species of fauna with a small frame such as anphibia, reptalia and birds.

Among mammals carnivores species the most important specie which could occur within the study area is *Lutra lutra* (*Figure 5.6.2.4a*).

Figure 5.6.2.4a   Lutra Lutra Distribution



From: Prigioni 1996

Concerning fish fauna, in Porto Romano bay there are very important areas for the reproduction of some fish species such as *Dicentrarchus labrax*. Other fish species which occur in the area are: *Mugil spp*., *Sparus aurata*, *Solea vulgaris* and *Anguilla anguilla*.

The expected species in the study area are presented in the following table, together with their habitat and their endangered level. The fishes occur at a depth from 10 to 50 meters.

Table 5.6.2.4a List of Expected Species in the Study Area

Species	Habitat	Endangered Level
	Fishes	
Arnoglossus laterna	Sea	-
Anguilla anguilla	Sea	-
Boops boops	Sea	-
Citharus linguatula	Sea	-
Dicentrarchus labrax	Sea	-
Deltentosteus quadrimaculatus	Sea	-
Dentex dentex	Sea	-
Diplodus annularis	Sea	-
Gobius niger jozo	Sea	-
Lepidopus caudatus	Sea	-
Lepidotrigla cavillone	Sea	-
Lophius budegassa	Sea	-
Merluccius merluccius	Sea	-
Mugil spp.	Sea	-
Mullus barbatus	Sea	-
Pagellus acarne	Sea	-
Pagellus erythrinus	Sea	-
Scorpoena notata	Sea	-
Serranus cabrilla	Sea	-
Serranus hepatus	Sea	-
Solea vulgaris	Sea	-
Sparus aurata	Sea	-
Spicara flexuosa	Sea	-
Trigla lucerna	Sea	-
Trigloporus lastoviza	Sea	-
Trisopterus minutus	Sea	-
Raja asterias	Sea	IUCN LR
Raja miraletus	Sea	-
Scyliorhinus canicula	Sea	-
	Birds	
Alectoris graeca	Mediterranean shrub	Annex 2/I Dir. 79/409
Coturnix coturnix	Semi-natural grassland/Cultivated land	Annex 2/I Dir. 79/409
Anas crecca	Salt Marsh Land	
Anas platyrhynchos	Salt Marsh Land	Annex 2/I Dir. 79/409
Aythia ferina	Salt Marsh Land	-
Aythia nyroca	Salt Marsh Land	Annex 1 Dir. 79/409 IUCN VU A1
Podiceps cristatus	Salt Marsh Land	-
Dendrocopos syriacus	Orchard/Cultivated land	-
Jynx torquilla	Orchard/Cultivated land	-
Upupa epops	Semi-natural grassland/ Mediterranean shrub	-
Merops apiaster	Semi-natural grassland/ Mediterranean shrub	-
Cuculus canorus	All	-
Apus apus	Semi-natural grassland/Cultivated land	-
Tyto alba	Semi-natural grassland/Cultivated land	-
Athene noctua	Semi-natural grassland/ Cultivated land/rock cliff	-
Otus scops	Semi-natural grassland	Annex 1 Dir.79/409

Species	Habitat	Endangered Level
Streptopelia decaocto	Semi-natural grassland/ Cultivated land	Annex 2/II Dir. 79/409
Galinula chloropus	Salt Marsh Land /cultivated land	-
Fulica atra	River	Annex 2/II Dir. 79/409
Tringa erythropus	Salt Marsh Land	Annex 2/II Dir. 79/409
Himantopus himantopus	Salt Marsh Land	Annex 1 Dir. 79/409
Tringa totanus	Salt Marsh Land	Annex 2/II Dir. 79/409
Actitis hypoleucus	Salt Marsh Land	-
Charadrius dubius	Flood plane	-
Vanellus vanellus	Cultivated land	Annex 2/II Dir. 79/409
Chlidonias niger	Wetland	Annex 1 Dir.79/409
Gavia artica	Sea/wetland	Annex 1 Dir.79/409
Sterna albifrons	Sea/wetland	Annex 1 Dir.79/409 IUCN LC
Sterna hirundo	Sea/wetland	Annex 1 Dir.79/409
Sterna caspica	Sea/wetland	Annex 1 Dir.79/409 IUCN LC
Accipiter gentilis	Semi-natural grassland/wood	-
Accipiter nisus	Semi-natural grassland/wood	-
Buteo buteo	Semi-natural grassland/ Cultivated land/wood	IUCN LC
Circus aeruginosus	Wetland	Annex 1 Dir.79/409 IUCN LC
Circus macrourus	Pine woods/open land	Annex 1 Dir.79/409 IUCN NT
Hieraaetus fasciatus	Semi-natural grassland/ Cultivated land/wood	Annex 1 Dir.79/409
Milvus migrans	Semi-natural grassland/ Cultivated land/River	Annex 1 Dir.79/409
Falco peregrinus	Semi-natural grassland/ Cultivated land/rock cliff	Annex 1 Dir.79/409
Falco tinnunculus	Semi-natural grassland/ Cultivated land	-
Falco vespertinus	Open land	-
Egretta alba	Semi-natural grassland/ Cultivated land/River/ Riparian wood	Annex 1 Dir.79/409
Ardea cinerea	Semi-natural grassland/ Cultivated land/River/ Riparian wood	-
Egretta garzetta	River/ Riparian wood	Annex 1 Dir.79/409
Phalacrocorax carbo	Wetland	
Phalacrocorax pygmeus	Wetland	Annex 1 Dir.79/409 IUCN LR
Pelicanus crispus	Wetland	-
Lanius collurio	Mediterranean shrub	Annex 1 Dir.79/409
Lanius excubitor	Mediterranean shrub/wood	-
Lanius minor	Semi-natural grassland/ Cultivated land Mediterranean shrub	Annex 1 Dir.79/409
Lanius senator	Mediterranean shrub	-
Corvus corax	All	-
Corvus frugilegus	Cultivated land	-
Corvus monedula	Mediterranean shrub/ Semi natural grassland	-
Garrulus glandarius	All	-
Pica pica	All	-
Erithacus rubecula	Semi-natural grassland/ Cultivated land	-

Species	Habitat	Endangered Level
Oenanthe hispanica	Semi-natural grassland/ Cultivated land	-
Oenanthe oenanthe	Semi-natural grassland/ Cultivated land	-
Delichon urbica	Semi-natural grassland/ Cultivated land	-
Hirundo rustica	Semi-natural grassland/ Cultivated land	-
Riparia riparia	River/Sand	-
Sylvia spp.	Wood	-
Galerida cristata	Semi natural grassland	-
Motacilla flava	Semi-natural grassland/ Cultivated land	-
Motacilla alba	Semi-natural grassland/ Cultivated land	-
	Amphibia	
Bombina variegata	Pools	IUCN LC, Annex II,IV Dir.92/43
Bufo bufo	Pools	IUCN LC
Pseudepidalea viridis	Pools	-
Rana dalmatina	Woods/ Semi-natural grassland	IUCN LC, Annex IV Dir.92/43
Rana graeca	Pools	IUCN LC, Annex IV Dir.92/43
Pelophylax ridibundus	Woods /Pools	-
Pelophylax kurtmuelleri	Woods /Pools	-
Salamandra salamandra	Woods /Pools	IUCN LC
Lissotriton vulgaris	Woods /Pools	-
Triturus cristatus	Woods /Pools	IUCN LC
	Reptalia	
Testudo hermanni	Semi-natural grassland/Cultivated land/ Mediterranean shrub/Woods	Annex II,IV Dir.92/43
Emys orbicularis	Wetland	Annex II,IV Dir.92/43 IUCN LR
Mauremys rivulata	Wetland	-
Hemidactylus turcicus	All	-
Mediodactylus kotscyi	Semi-natural grassland/Cultivated land/ Mediterranean shrub/Woods	-
Ablepharus kitaibelii	Semi-natural grassland/Cultivated land/ Mediterranean shrub/Woods	IUCN LC
Anguis fragilis	Mediterranean shrub	-
Pseudopus apodus	Semi-natural grassland/Mediterranean shrub	Annex IV Dir.92/43
Algyroides nigropunctatus	Semi-natural grassland/Mediterranean shrub	-
Lacerta trilineata	Semi-natural grassland/Mediterranean shrub	IUCN LC Annex IV Dir.92/43
Lacerta viridis	Semi-natural grassland/Mediterranean shrub	Annex IV Dir.92/43
Podarcis muralis	All	IUCN LC Annex IV Dir.92/43
Dolichophis caspius	Semi-natural grassland/Mediterranean shrub	-
Elaphe quatuorlineata	Semi-natural grassland/Mediterranean shrub	Annex II,IV Dir.92/43
Hierophis gemonensis	Semi-natural grassland/Mediterranean shrub	-
Malpolon insignitus	Mediterranean shrub	-
Natrix natrix	Woods/Pools	IUCN LC
Natrix tessellata	Wetland	Annex IV Dir.92/43
Platyceps najadum	Mediterranean shrub	-

Species	Habitat	Endangered Level
Telescopus fallax	Mediterranean shrub	Annex IV Dir.92/43
Zamenis longissimus	Semi-natural grassland/Mediterranean shrub	Annex IV Dir.92/43
Zamenis situla	Semi-natural grassland/Mediterranean shrub	Annex II,IV Dir.92/43
Vipera ammodytes	Woods/ Mediterranean shrub	Annex IV Dir.92/43
	Mammalia	
Erinaceus concolor	Semi-natural grassland/Cultivated land/ Mediterranean shrub/Woods	-
Suncus etruscus	Semi-natural grassland/Cultivated land/ Mediterranean shrub/Woods-	-
Talpa caeca	Mediterranean shrub	-
Talpa stankovici	Mediterranean shrub	-
Myotis myotis	Semi-natural grassland/Cultivated land	Annex II,IV Dir.92/43
Myotis mystacinus		Annex IV Dir.92/43
Pipistrellus kuhlii	Mediterranean shrub/Rock Cliff	Annex IV Dir.92/43
Pipistrellus nathusii	Wood	Annex IV Dir.92/43
Pipistrellus pipistrellus	Cultivated land	Annex IV Dir.92/43
Lepus europaeus	Cultivated land	-
Microtus felteni	Semi-natural grass land	Endemic of western balkan
Microtus thomasi	Semi-natural grass land	Endemic of western balkan
Mus spicilegus	Semi-natural grassland/Cultivated land	-
Vulpes vulpes	Woods/ Semi-natural grassland/Cultivated land	-
Mustela nivalis	Semi-natural grassland/Cultivated land/ Mediterranean shrub/Woods	-
Mustela putorius	Wood (riparian)/ Semi-natural grassland	Annex V Dir.92/43
Martes foina	Semi-natural grassland/Cultivated land/ Mediterranean shrub/Woods	-
Lutra lutra	Wood (riparian)/River	Annex II,IV Dir.92/43

5.6.2.5. *Conclusion*

Among the species which are expected to occur in the study area, some of them are endangered and need protection. The most important terrestrial species are *Lutra lutra* and *Myotis myotis,* which need habitats of good quality.

The presence of fauna in the study area is strictly related to the quality of natural habitats, which can be spoilt by direct discharge of untreated urban and industrial wastewater, excessive felling of trees for fuel, excessive erosion phenomena, uncontrolled hunting and fishing and human disturbance.

Unfortunately, many data gaps on the species composition in the study area and in the surrounding areas do not allow to assess carefully the importance of the fauna which live in the study area.

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5.7. LANDSCAPE

The present analysis of the landscape quality of the Power Plant site was performed applying the following methodology:

- *Historical overview*, aimed at identifying the main events related to the historical evolution;
- *Identification* of the *Study area Landscape and Territorial Protection Restrictions*;
- *Present landscape characterization,* on the site landscape feature;
- Study area *Landscape sensitivity analysis*.

5.7.1. *Analysis Methodology*

The methodology adopted for the landscape impact analysis comprises the identification of the *Study area* sensitivity and the subsequent evaluation of the proposed project incidence (i.e. the specific impact level for the selected environment). The landscape impact level is determined by combining the obtained results for *Study Area Sensitivity* and *Project Incidence*.

The landscape sensitivity is evaluated based on the following components:

- *Morphologic and Structural Component*, the landscape sensitivity assessment is carried out elaborating and aggregating intrinsic and specific values of the following basic landscape patterns: morphology, natural features, level of protection, heritage values;
- *Visual component*, takes into account the landscape perception of panoramic values and significant views. The characterizing element of this components is the scenic viewpoint identified, known and used by tourists or locals as privileged observation point for panoramic reasons observation ;
- *Symbolic component,* referred to the landscape symbolic value, as perceived by local communities. This characterizing element of this component is the Landscape Singularity.

Table 5.7.1a Landscape Sensitivity Assessment – Synthesis of the Considered Elements

Components	Landscape Features	Evaluation Criteria
Morphologic and Structural	Morphology Natural features Protection Heritage values	Visible peculiar landform elements Visible landscape systems of natural interest (presence of ecological network or significant natural areas) Level and number of protected landscape and cultural elements Presence of visible settlement elements of historical interest Visible signs of the cultural elements of the landscape
Visual	Scenic viewpoints	Visibility of a wide landscape area/inclusion in scenic views
Symbolic	Landscape Peculiarity	Rarity of landscape elements Notoriety for artistic, historical or literary reasons (touristic attraction)

The following classification was applied for the synthetic assessment of landscape sensitivity:

- *Very low* Landscape sensitivity;
- *Low* Landscape sensitivity;
- *Medium* Landscape sensitivity;
- *High* Landscape sensitivity;
- *Very high* Landscape sensitivity.

5.7.2. *Historical Overview*

The project site is close to the city of Durrës, one of the most important cities of Albania both economically and historically .

Durrës was founded as Epidamnos in 627 BC by Greek colonists from Corinth and Corfu. Its geographical position was highly advantageous, being situated around a natural rocky harbour which was surrounded by inland swamps and high cliffs on the seaward side, making the city very difficult to attack from either land or sea.

Epidamnos was seized by Glaukias, the king of Illyria, in 312 BC, but after a war with the Roman Republic in 229 BC ended in a decisive defeat for the Illyrians the city passed to Roman Rule. The Romans renamed it Dyrrachium.

In the 4th century AD, Dyrrachium was made the capital of the Roman province of Epirus nova. Some time later that century, Dyrrachium was struck by a powerful earthquake which destroyed the city's defences. Anastasius I rebuilt and strengthened the city walls, thus creating the strongest fortifications in the Western Balkans. The 12m (36ft)-high walls were so thick that four horsemen could ride abreast on them. Significant portions of the ancient city defences still remain, although they have been much reduced over the centuries.

Following the fall of the Roman Empire, the city passed to the Byzantine Empire and continued to be an important port and a major link between the empire and Western Europe.

Due to Durrës strategic location, during the centuries, the city was conquered several times, passing under several empires: Normans, Republic of Venice, Serbian.

More recently, Durrës was an active city in the Albanian national liberation movement in the periods 1878-1881 and 1910-1912. The city became Albania's first national capital on March 7, 1913.

During the First World War, the city was occupied by Italy in 1915 and by Austria-Hungary in 1916-1918. It was captured by the Allies in October 1918. Restored to Albanian sovereignty, Durrës became the country's temporary capital between 1918 and March 1920. It experienced an economic boom due to Italian investments and developed into a major seaport, with a modern harbour being constructed in 1927.

An earthquake in 1926 damaged some of the city and the rebuilding that followed gave the city its more modern appearance.

The Second World War saw Durrës (called Durazzo again in Italian) and the rest of Albania being annexed to the Kingdom of Italy between 1939-1943, then occupied by Nazi Germany until 1944. Durrës's strategic value as a seaport made it a high-profile military target for both sides. The city was heavily damaged by allied bombing during the war and the port installations were blown up by the retreating Germans in 1944.

The Communist regime of Enver Hoxha rapidly rebuilt the city following the war, establishing a variety of heavy industries in the area and expanding the port. It became the terminus of Albania's first railway, begun in 1947.

Following the collapse of communist rule in 1990, Durrës became the focus of mass emigrations from Albania with ships being hijacked in the harbour and sailed at gunpoint to Italy.

In 1997, Albania slid into anarchy following the collapse of a massive pyramid scheme which devastated the national economy. An Italian-led peacekeeping force was controversially deployed to Durrës and other Albanian cities to restore order, although there were widespread suggestions that the real purpose of "Operation Alba" was to prevent economic refugees continuing to use Albania's ports as a route to migrate to Italy.

During the 1999 Kosovo War the city hosted some 110,000 refugees fleeing fighting in Kosovo and became a base of operations for much of the refugee response by aid agencies in Albania.

As in other parts of Albania, numerous concrete bunkers built under the old dictatorship are situated in and around Durrës. They can be found every 100 to 150 meters along the city's beach. They were built to defend the country from a supposed foreign attack from either the West or the Warsaw Pact which never happened.

As shown in *Figure 5.7.2a*, the *Study Area* is characterized by the presence of numerous bunkers.

Figure 5.7.2a *Concrete Bunkers, built under the old dictatorship in the Study area*

More specifically about the Porto Romano village history, it seems likely that by Early Hellenistic times all of the area east of the coastal ridge between Durrës and Porto Romano was being used for agricultural purposes (2) . At this time a substantial settlement also appears to have existed at Porto Romano. Large numbers of graves and grave markers of Archaic through Early Roman date have been located in the valleys north and northwest of Durrës. Some graves have been found closer to the marsh in the area between Spitalla and Porto Romano.

5.7.3. *Restrictions*

The Environmental and Cultural Restrictions in the *Study Area* has been identified by analysing the following sources:

(2) Source: The Durrës Regional Archaeological Project: Archaeological Survey in the Territory of Epidamnus/Dyrrachium in Albania - Jack L. Davis; Afrim Hoti; Iris Pojani; Sharon R. Stocker; Aaron D. Wolpert; Phoebe E. Acheson; John W. Ha - Hesperia, Vol. 72, No.1 (Jan. – Mar. 2003).

- *Protected areas* identified by Albanian Law (*Law n°8906, 6^{th} June 2002*), classified according to IUCN (the World Conservation Union), 1994 Guidelines (*Figure 5.6.2.2a*);
- *Environmental monuments* catalogue: according to *Decision n°676 of 2002*, the sites already included in the 1981 *Environmental monument* catalogue, has been subject to the same protection regime foreseen for the *Environmental monument* identified by *Law n°8906, 6^{th} June 2002 (*Law on Protected Areas*);*
- *Cultural Heritages:* through site historical analysis, analysing literature data (such as archaeological studies) and identifying the significant cultural heritages closed to the selected site, if any.

Protected areas located nearby the selected site are listed in the following *Table 5.7.3a*. According to *Law n°8906, 6^{th} June 2002* and IUCN Guidelines, Protected Areas are classified as follows:

- Category I: Strict Nature Reserve;
- Category II: National Park;
- Category III: Natural Monument;
- Category IV: Habitat/Species Management Area;
- Category V: Protected Landscape/Seascape;
- Category VI: Managed Resource Protected Area.

Table 5.7.3a Protected Areas (as identified by Law 8906, dated 6^{th} June 2002) in the Study Area

Category	Region (Prefektura)	Province (Rreth)	Protected Area	Designation	Surface (ha)	Distance (km)
I	*No Category I areas are present close to the selected site*					
II	*No Category II areas are present close to the selected site*					
III	*No Category III areas are present close to the selected site*					
IV	Durrës	Durrës	Rrushkull	Urdhër MB Nr.2, dated 26^{th} December 1995	650,0	~7
V	*No Category V areas are present close to the selected site*					
VI	*No Category VI areas are present close to the selected site*					

As reported in the previous Table only one Protected Area is located in the surroundings of Porto Romano Power Plant site, and precisely 7 km northern from the site, just north of the Erzen river mouth, and is protected since 1995 as Habitat/Species Management Area. The wetland Rrushkull Area is also classified as Important Bird Area (IBA) thanks to the presence of over 10,000 Waterbirds [3].

No Environmental monuments(4) there are located in the Study Area.

The above reported historical information the site is not expected to host archaeological values. The nearest cultural heritage findings are:

- The *segment of a mortared Roman brick wall* located on the Porto Romano coastal ridge (about 1,5 km southern to the Power Plant site);

(3) Source: Integrated Safeguards Data Sheet - Integrated Water & EcoSystems Management Project – World Bank
(4) Natural formation - including peculiar trees - of a surface up to 50 hectares, particular geological and geo-morphological formation, a mineral deposit or a rare and endangered species or of a special, scientific, aesthetic value and importance shall be declared Natural monuments

- The *archaeological findings* located southern site of the Spitalla headland.

With reference to archaeological values of the investigated area, ICAA (International Centre for Albanian Archaeology), in partnership with the Durrës museum and an Italian archaeological teams, is working to reconstruct the complex history of this great Adriatic centre.

As depicted by the following *Figure 5.7.3a*, southern site of the Spitalla headland a prehistoric site, an archaic temple and two new necropolis sites were found (source ICAA Review Report 2006).

Figure 5.7.3a Porto Romano Archaeological Sites

A segment of a mortared brick wall of Roman style was found in the northern most part of the Porto Romano coastal ridge (*Source: The Durrës Regional Archaeological Project: Archaeological Survey in the Territory of Epidamnus/Dyrrachium in Albania*). The *Porta Romana wall*, the sunken *Hellenistic village* and archaeological sites such as the *Archaic temple*, the possible location of the *emporion* and the *prehistoric site* were proposed for designation as national archaeological park.

In the area to the south of Porto Romano findings there is a post-World War II Munitions Plant.

The above mentioned archaeological areas are located close to the Power Plant area (*Figure 5.7.3a*) but outside the perimeter of the site.

5.7.4. *Present Landscape Component*

The project site is located in the large costal plain to the North of Durrës. A low hill (49 m asl maximum height), located immediately north of the Porto Romano Power Plant separates the Porto Romano Gulf from the Lalzi Gulf. South from the site a low relief (about 100 masl maximum height) arises along the coastal line, protecting Porto Romano settlements from the seaside.

The area was occupied by wetlands and was subject to reclamation in the 60s. A regular network of reclamation channels and irrigation canals characterizes the area (*Figure 5.7.4a*).

Figure 5.7.4a Network of Reclamation Channels

The land use is characterized mainly by spontaneous vegetation (mainly Mediterranean scrub, characterized by little bush) and semi natural grassland (*Figure 5.7.4b*). Semi natural grasslands are the results of the combined effects of natural processes and anthropogenic activities (such as cow grazing).

Figure 5.7.4b Semi natural Grass Land

Various tracts of the landscape along the coast line are visually strongly characterized by the presence of hydrocarbon depots and other installations.

Figure 5.7.4c View from Porto Romano Hill

Figure 5.7.4d View from Spitalla Headland

As shown in the previous Figures the landscape around the study area can be defined as a semi-natural environment. In fact, in the Porto Romano coastal plain there are only a few houses and little farms.

Some landscape quality detractors are located in the *Study area* and follows described:

- Tank Farms for hydrocarbons and gas storage, as shown by *Figure 5.7.4c* and *Figure 5.7.4e*;
- Loading and unloading jetty connected to hydrocarbons and gases cut across the Porto Romano bay;
- A Drainage pumping station, located closed to Porto Romano town, in the southern part of the bay.

Figure 5.7.4e Tank Farm

5.7.4.1. *Morphological and Structural Components*

The morphological component of the study area is characterized by the large costal plain. Only a low hill (49 masl maximum height), located immediately at north of the Porto Romano Power Plant separates the Porto Romano Gulf from the Lalzi Gulf. South from the site a low relief (about 100 masl maximum height) arise along the coastal line, protecting the Porto Romano settlements from the seaside.

Although a regular network of drainage channels characterizes the area, giving a geometric texture, due to lacking of vertical elements (such as trees rows or riparian strips) a real structural landscape component is not perceivable.

Considering the above the area is classified as *Low landscape sensitivity*.

5.7.4.2. *Visual Components*

In the *Study area* there aren't scenic view points and the lacking of elevated points limits the possibilities for landscape fruition.

The only potential users of the aesthetic qualities of the Porto Romano bay could be the tourists of the sea lido, located in the northernmost part of the Porto Romano Gulf, immediately south from the Spitalla headland (fruition limited in terms of users' number and seasonal).

Considering the above the area is classified as *Medium*.

5.7.4.3. *Symbolic Components*

The *site* is located inside an area of poor symbolic patterns. The unique symbolism that characterizes the Porto Romano coastal plain is the disseminated lines of concrete bunker, as testimonial of a territory oppressed by last century conflicts.

Considering the above the area is classified as *Low landscape sensitivity*.

5.7.5. *Conclusions*

The following *Table 5.7.5a* report the synthesis of the landscape sensitivity assessment carried out taking into account the above mentioned considerations and analysis.

The overall sensitivity of the *Study Area* is classified as *Low*.

Table 5.7.5a Study area landscape sensitivity assessment

Components	Landscape Features	Weight assigned
Morphologic and Structural	Morphology Ecological quality Protection Heritage values	Low
Visual	Scenic view points	Medium
Symbolic	Landscape singularity	Low

5.8. NAVAL TRAFFIC AND ROAD NETWORK

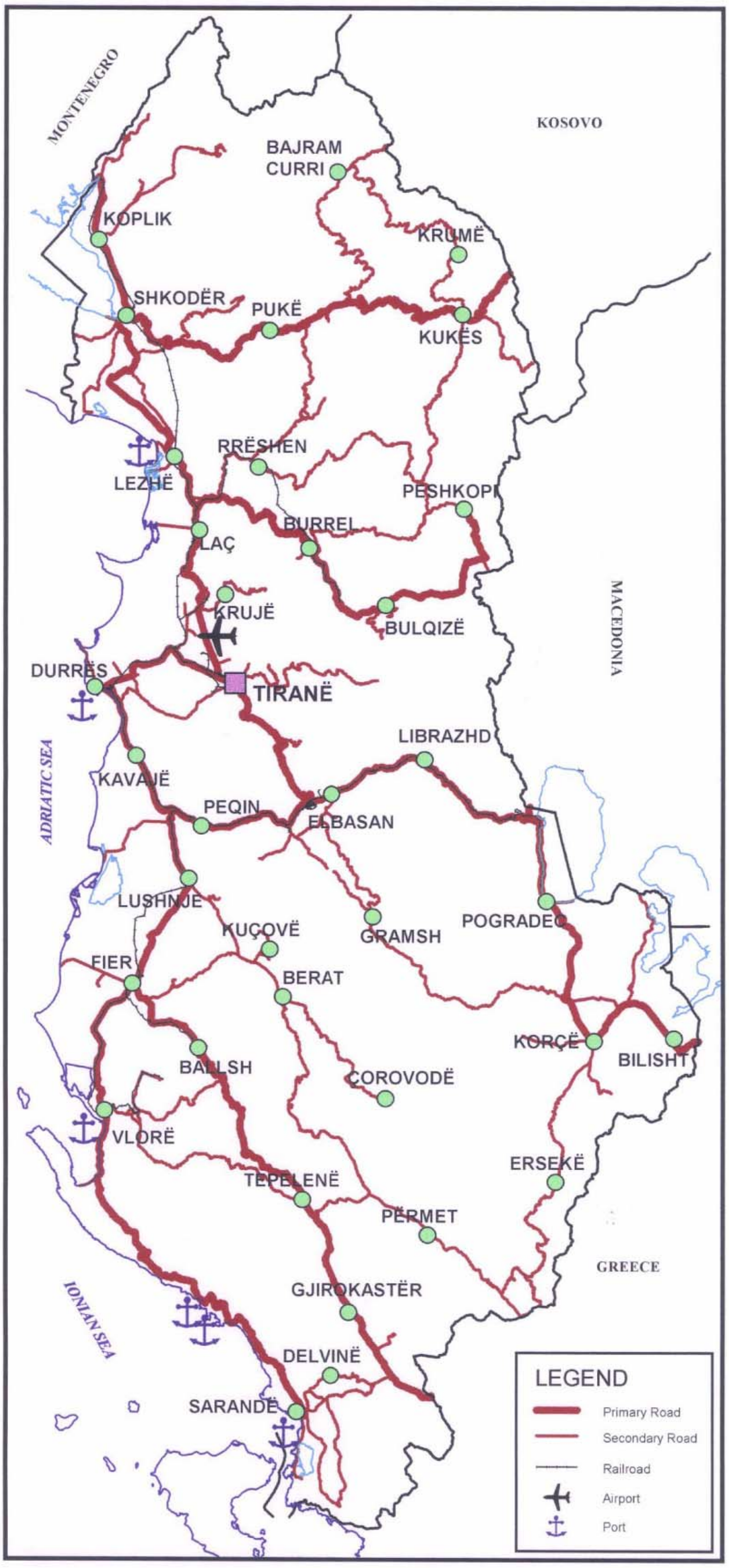
This paragraph provides a brief description of the following issues:

- Existing Road Network description;
- Durrës Naval Port activities and situation.

5.8.1. *Existing Road Network*

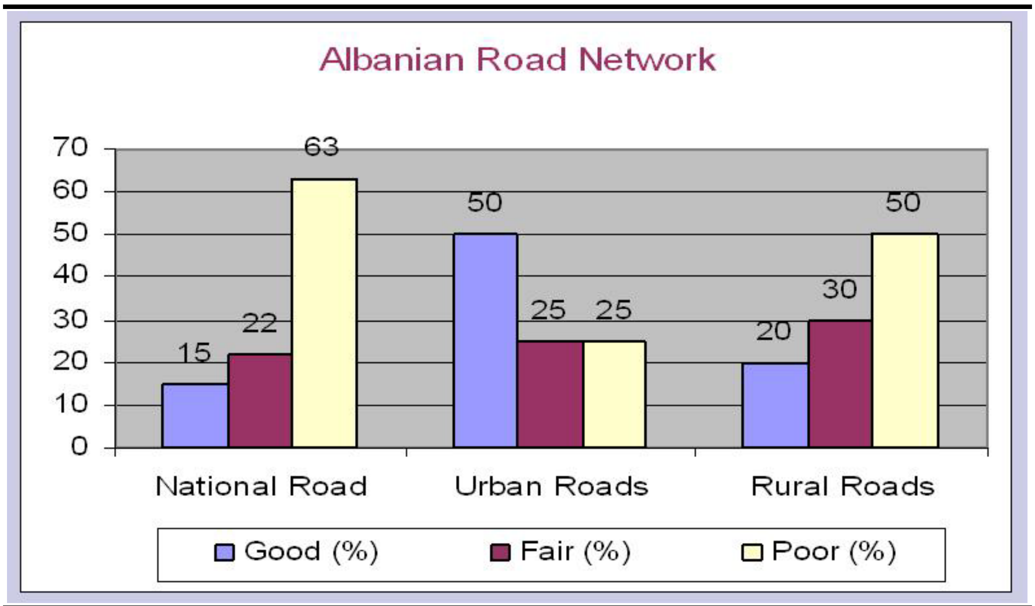
The road network in Albania is approximately 18,000 km including all classes of roads, that is 3,136 km of National Roads, 10,500 to 11,000 km of District and Communal Roads 4,000 km of other roads under the jurisdiction of different autonomous bodies, enterprises or companies (*Figure 5.8.1a*).

Figure 5.8.1a Primary and Secondary Road Network of Albania



Only the 12.4 % of the roads are paved and the road network has a density of about 0.62 km/km^2. In general the road quality is poor (*Figure 5.8.1b*).

Figure 5.8.1b *National Road Network Quality*



The main road in the area of the project site is the primary road connecting Durrës with Tirana. It is a two-lane road for each direction.

Two other important roads are present in the plain area north of Durrës (*Figure 5.8.1c*):

- Durrës – Rina
- Durrës – Porto Romano.

Both are secondary roads, with one lane for each direction that were built to connect the former chemical complex at Porto Romano with Durrës Port. Considering that the former chemical industries are now dismissed, the traffic is now limited to local inhabitants commuting to Durrës and by a few trucks moving to the new industrial areas of Porto Romano.

All other roads present in the area are unpaved rural roads.

Figure 5.8.1d Road Network in the Plain Area North of Durrës

5.8.2. *Naval Traffic of the Durrës Port*

There are four main ports in Albania. The average capacity of cargo traffic through the ports of Albania is about 5 million tons per year.

The Port of Durrës is located in the southern portion of the Adriatic Sea, to the South of the town of Durrës , which is located in the northern part of the Bay of Durrës . The Bay of Durrës is well protected by the Durrës Cape which provides a natural barrier from waves. The main breakwater was built in direction south-east to protect the harbour from on the southern side. The port is effectively enclosed by an eastern mole type breakwater. The access is a buoyed entrance channel.

Durrës is Albania's main port with 77% of the country's imports and 89% of country's export tonnage, totalizing 78% of Albania's traffic. The actual level of traffic is about 3.1 million t per year. Cargo traffic is quite unbalanced between imports, over 91% of total throughput, and exports, less than 9% of total throughputs. An increasing share, though still small, of the total traffic is shipped in containers. The Congestion factor for the port has been significantly reduced over the years from 1.00 six years ago to 0.39 in 2003. The traffic forecast for the port of Durrës is estimated to reach 8.5 million t in 2023 which represents an average annual growth of 5.9 % since 2003.

The Port of Durrës handles all types of cargo including dry bulk, break bulk, liquid bulk, general cargo, chemicals, dangerous cargo, containers etc. It consists of *imports* of various kinds of goods such as wheat, cement, fuels, construction material, foodstuff, scrap, containers etc., and *exports* of minerals like chrome, iron-chrome, etc..

Figure 5.8.2a,b show data about the traffic volume and import/export distribution at Durrës Port.

The data show an increase in the Volume of Work of about 60% between 2001 and 2005. The import traffic represents more than 85% of the overall activities. Export traffic has been increasing since 2003.

Figure 5.8.2a Volume of Work in the Durrës Port

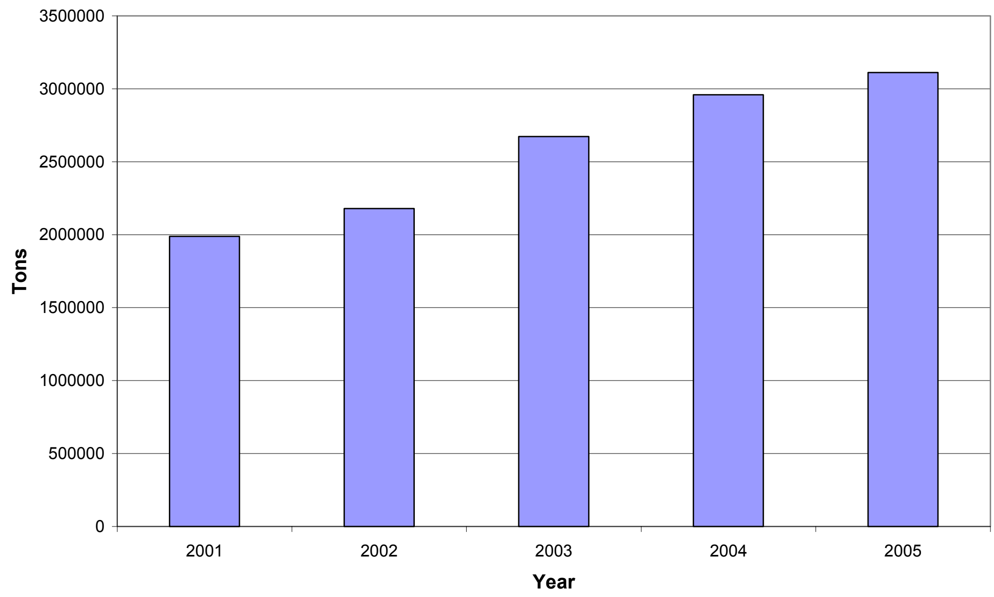
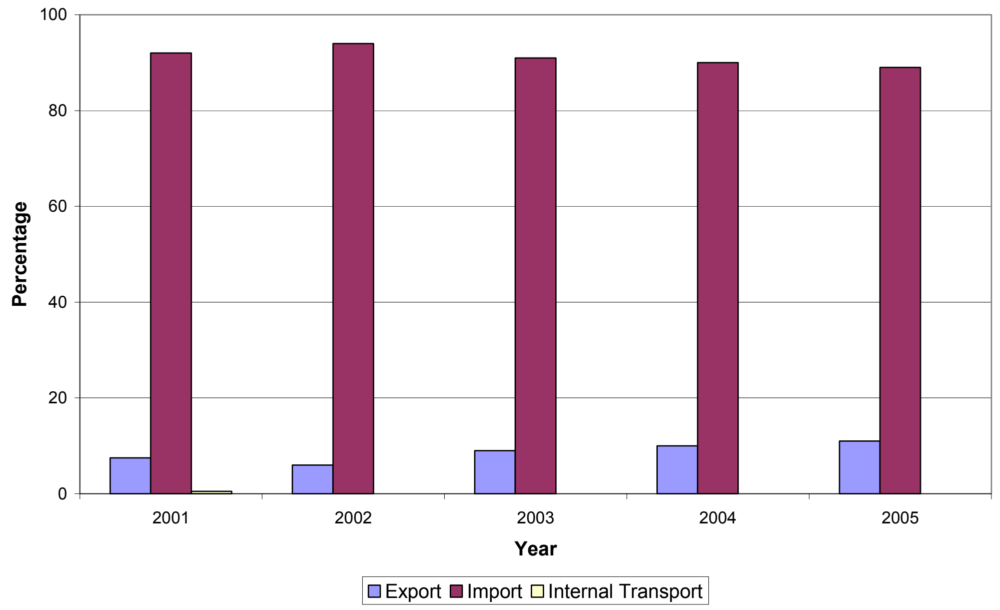


Figure 5.8.2b *Percentage of Activities in the Durrës Port*



Figures 5.8.2c,d show data on the trend in the share of types of goods transported at Durrës Port.

Figure 5.8.2c Imports, Durrës Port

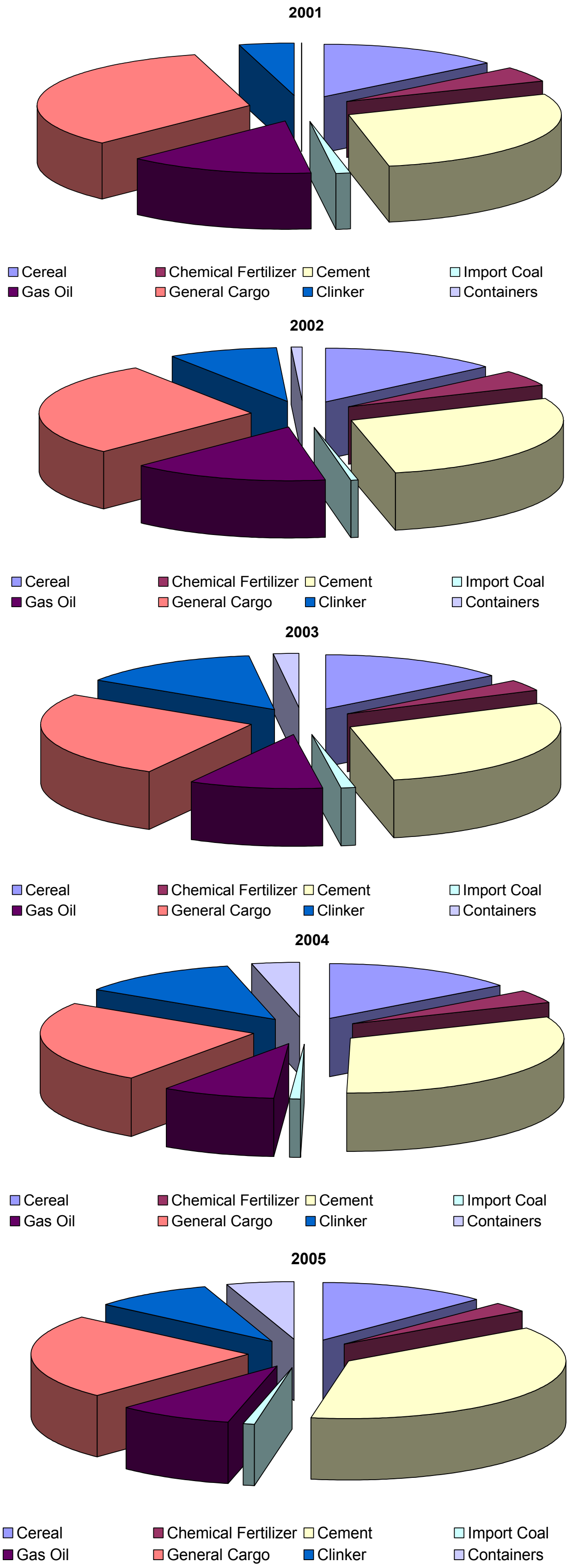
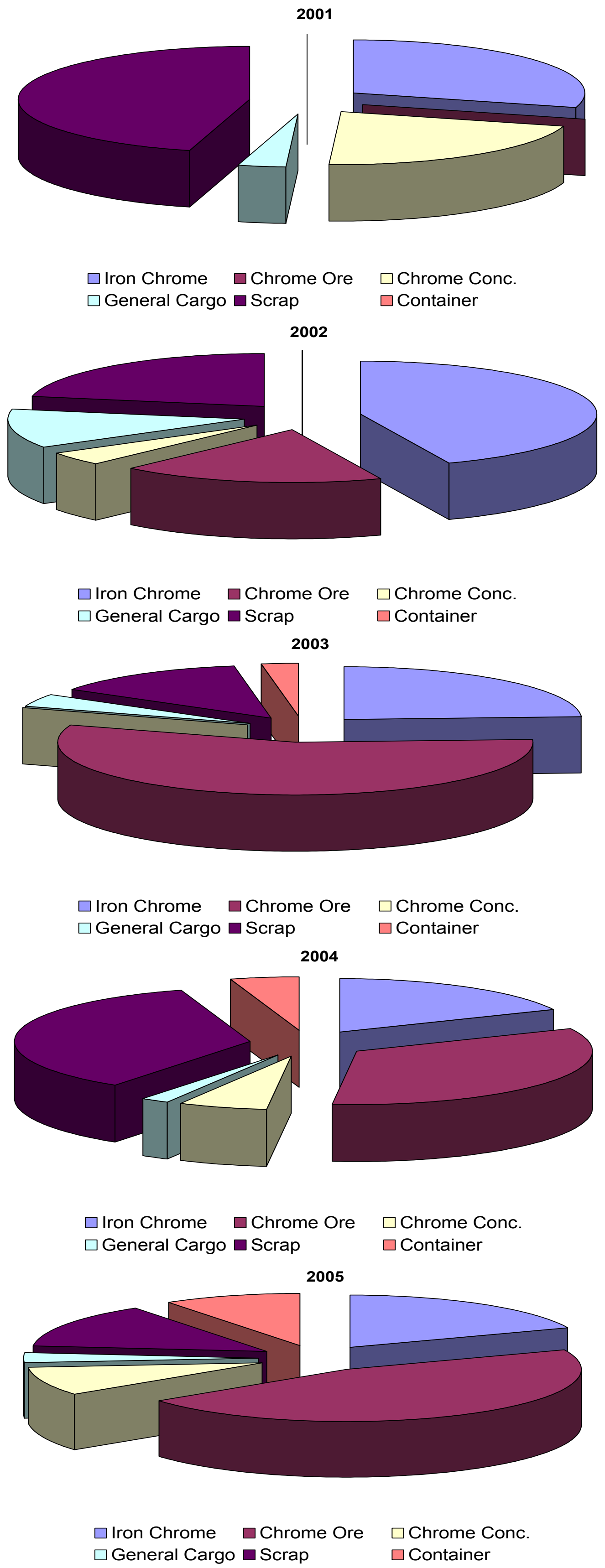


Figure 5.8.2d Exports, Durrës Port



Considering Import activities, the main sectors are general cargos and cement, while among the export activities the main sectors are represented by Chrome and Iron minerals.

These annotations confirm the general trend evidenced in the Albania National Transport Plan. This document reports that in terms of volumes, the following commodities are dominating freight transport in Albania:

- *Foreign trade*: (76% of the present traffic of the port of Durrës)
- *Exports* : minerals (ferro-chrome)
- *Imports* : construction materials (cement and clinker, bricks and tiles, steel bars and sheets), wheat and flour, fertilisers, petroleum products,
- *Domestic trade*: cereals, beverages, vegetables and fruits (transported over short distances, often within the same district)
- *Transit traffic*: construction materials, agricultural products.

5.9. NON IONIZING ELECTROMAGNETIC FIELDS

Powerlines, electrical stations and electricity generators do not produce ionizing radiations. The only type of radiation that can be associated with these installations are non ionizing radiations. These are formed by electric fields and low frequency magnetic induction (50Hz), produced by the powerline voltage, electrical machineries and by the electricity.

Other non ionizing radiation sources are radio, radiotelephonic antennas and radar systems. The emission frequencies of these instruments are very high compared with industrial frequencies. For this reason, effects on matter and on human body, are different. High frequency radiations mainly produce thermal effects, while low frequency radiations interact with the biological mechanisms of signal transmission in the human body.

No power lines presently cross the site area. No relevant induced electromagnetic field is present.

5.10. SOCIOECONOMIC FRAMEWORK

5.10.1. *Demographic Data*

The Albanian population has a low average age (about 32 years). In the beginning of 90-s, the political changes were associated with movement of population in whole Albania. The population that lived in the undeveloped places of the highlands, mainly in the North of the country, moved to more developed zones including Durrës and its outskirts. These population movements were not registered.

Due to this uncontrolled movement of people the ratio of rural to urban population changed. The ten major urban centres accounted for 20% of the total population at the end of 1990 and for 36 % in 1999. By the end of 2001 the urban population had grown to 42.1%.

The area of Porto Romano was originally sparsely populated with most people living on the flanks of the hills. After the reclamation of the marsh around 1980, the population increased due to the presence of the factories and the increased possibilities for living and farming on the lowlands. In the last decade, Durrës area has experienced a fast and uncontrolled population growth, mostly by immigration of people from northern Albania and other regions looking for work and income. Currently some 5,000 to 7,000 people have settled on the flanks of Durrës hills and on Durrës plain.

Updated data on population statistics in the area of Porto Romano were collected during the investigations carried out on the area in the framework of remediation design projects (UNEP, *Feasibility Study for Urgent Risk Reduction Measures at Hot Spots in Albania*, 2001) and were retrieved through the declarations of Civil Registry Offices in different districts, which are compiled based on their administrative records. Those registers do not fully reflect movement of the population within and outside the country, due to unregistered resettling movements.

No recent and actual population data are available for the area of Porto Romano since a large portion of the settlements there is reportedly unregistered.

An estimation of Porto Romano population was carried out in the UNEP Feasibility Study and is reported in the following *Table 5.10.1a*.

Table 5.10.1a Porto Romano Population in 2003

Population Class	Number
Total	2,384
Children (age 0-1)	35
Children (age 1-14)	115
Adults	2,234

The data were calculated based on the number of houses observed on satellite images combined with an average number of inhabitants per house and age data, collected through a population survey on 86 households with 473 persons.

Another settlement is located at approximately 1 km distance to the East of the site (Rinia), with a number of dwelling houses around 350. The number of residents is not available.

According to interviews with ALUIZINI (Agency for the Legalization, Urbanization, Regional Integration of Informal Buildings) the informal settlements in Porto Romano, bordered by the localities identified as "Varrezat e Reja" and "Hidrovori", hosts 760 households belonging to the Municipality of Durrës , and the settlements of Rinia, includes approximately 200 buildings. ALUIZINI confirmed that all the buildings in the area are illegal.

5.10.2. *Socio-Economic Framework*

According to the *Country Profile on the Housing Sector (UN, 2002)* official statistics showed that 29.6% of Albanians are poor, half of them live in extreme poverty. One in three families is inadequately housed, infant and maternal mortality rates are high, 14% of children under the age of 5 are malnourished, 12% of children under 15 years of age are illiterate. Poverty is the highest in the north, in large families, headed by young or poorly educated people.

In 1996, 90% of the poor lived in rural areas. Half the poor are self-employed in agriculture; 20% are pensioners. There is a high level of inequality in the nationwide distribution of family income. In 1998, the top 20% of families received 48% of total family income, while the poorest 20% received only 5%. In Tirana 26% of the population lives on less than a dollar a day, while in Tirana's outskirts 36% do so.

Unemployment is one of the main causes of poverty in urban areas, while hidden unemployment is characteristic of rural areas. Unemployment is above average in the towns of Berat, Elbasan, Kurbin, Shkodra, Permet and Kucove. Unemployment in Albania is gender and age specific, with 21% of women unemployed and 16% of men. Some 60% of young adults aged 16 to 34 are unemployed and the situation is even worse in the cities: Vlore (86%), Mat (82%), Tirana (66%), Puke (65%) and Shkodra (63%). The social consequences are exacerbated by the fact that two thirds or more of the unemployed are no longer eligible for unemployment benefits. .

The main economic indicators for Albania are reported in *Table 5.10.2a.*

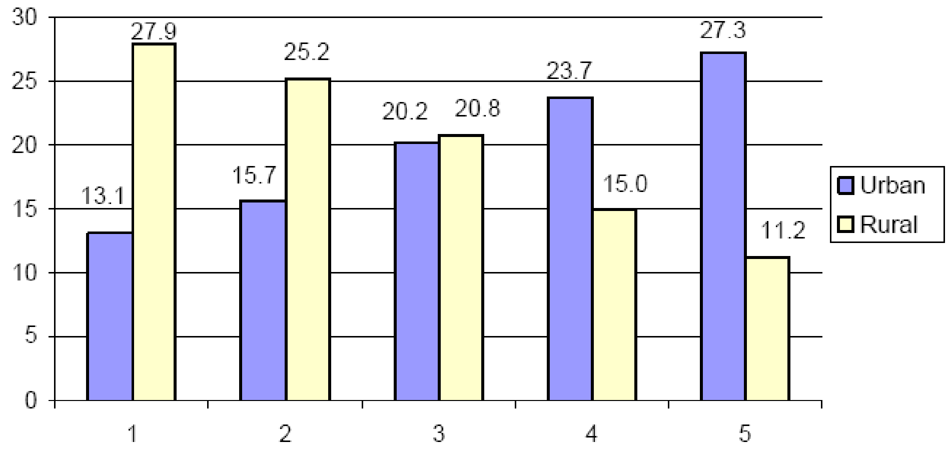
In 1998 the average income per household was 16,620 leks per month. In areas with fewer than 10,000 inhabitants, the income per household falls to 14,250 leks per month, while in areas with more than 10,000 inhabitants, incomes are 21,240 leks per month. This rural-urban disparity is clearly shown by the income quintiles for rural and urban areas and it partly explains the trends towards urban migration (*Figure 5.10.2a*).

Figure 5.10.2a Main Economic Indicators for Albania

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
GDP – total (in million leks)	16,813	16,404	50,697	125,334	184,393	229,793	280,998	341,716	460,631	506,205	536,640	590,237
GDP constant prices 1990	16,813	12,105	11,235	12,309	13,331	15,107	16,482	15,325	16,547	17,748	18,605	20,367
Real GDP growth		-28.0	-7.2	9.4	8.3	13.3	9.1	-7.0	8.0	8.0	7.8	6.5
GDP per capita (thousands)	5.1	5.1	15.9	39.6	57.6	70.7	85.6	102.8	137.3	154.7	$1094.4	$1332.6
constant prices 1990	5.1	3.7	3.5	3.9	4.2	4.6	5.0	4.6	4.9	5.3		
Avg. monthly wage				3,084	4,778	6,406	8,638	9,558	11,509	12,708	14,963	
Avg. consumer price index		35.5	226	85	22.5	7.8	12.7	42.07	20.6	16.3	0	3.10
Unemployment rate	-		27**	22	18	13	12	14.9	17.7	18.4	16.8	
Lek/US$	8.9	24	75	102	95	93	105	149	151	138	143.71	143.48
Lek/€										147	132.58	128.27

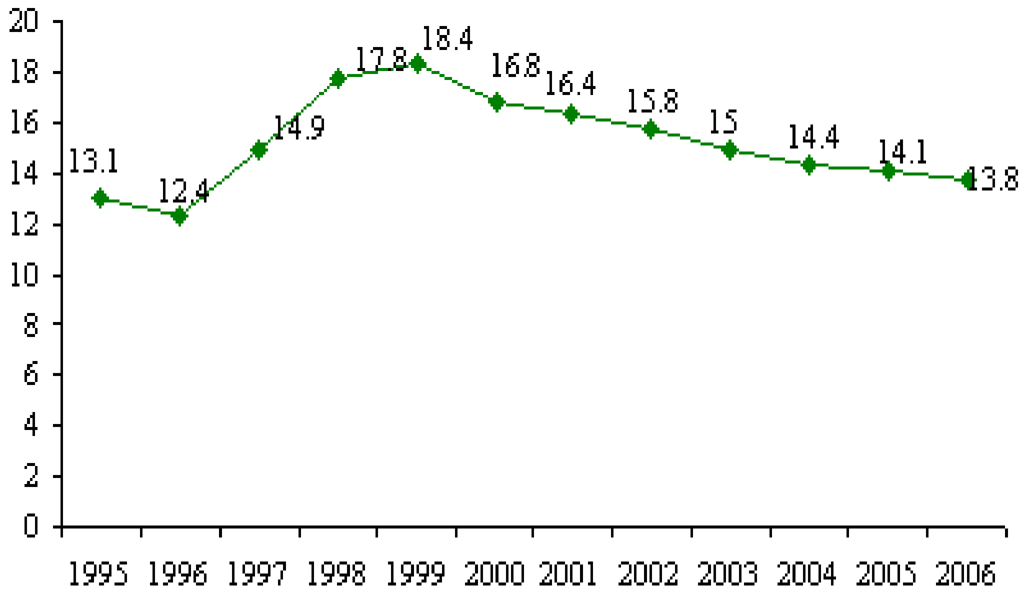
*EIU estimates.
** Draft strategy on growth and poverty reduction, 2001.
Sources: INSTAT, Albania in Figures 1997, 2000 and 2001; UNDP Human Development Report 2000, EIU Country Profiles and Report 2001 and 2002.

Figure 5.10.2a *Percentage of Population in Rural and Urban Areas According to Income Quintiles in 1998 (Quintile 1: Lowest Income, Quintile 5: Highest Income)*



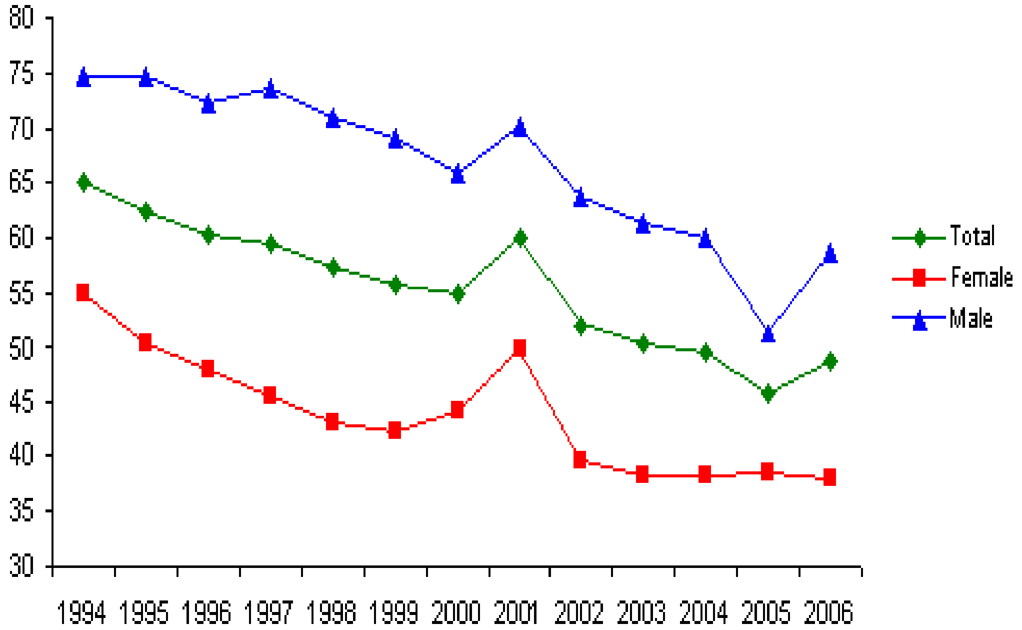
Unemployment and employment trends in Albania in the latest decade are shown in *Figures 5.10.2b* and *5.10.2c.*

Figure 5.10.2b *Unemployment in Albania*



Source: www.instat.gov.al

Figure 5.10.2c   Employment in Albania



Source: www.instat.gov.al

According to the *Rapid Environmental Assessment for the Industrial and Energy Parks at Porto Romano* (Landell Mills, Jun 2008) there could be up to 21,000 unemployed people in Durrës city and in the informal settlement of Porto Romano and a further 9.000 in neighbouring communes. The total number of unemployed people in the area would therefore be approximately 30,000 out of an area of 100,000 people.

The area of Porto Romano was used historically for industrial purposes since the '40s.

The history of the industrial installations on site is the following:

Sulphur site

- Estimation of 1982 to 1987 – Production of Zinc chloride, missing of Lindane with lime powder and a dumpsite of sulphur.

Lindane/Dichromate Plant

- 1944 to 1967 - A leather tanning factory
- 1967 to 1987 – Production of Dichromate, magnesium sulphate and aluminum sulphate used in leather tanning
- 1982 to 1987 – Production of Lindane and other pesticides such as sodium trichromate and Thiram

Several portions of the land inside the area of Hotspot 1 were privatized and are intended to be used for production activity in the near future. An cardboard packaging unit is presently active within the premises of Hotspot 1.

Dumpsite at Pumping Station

- Unprecised dates– Dumping included but not limited to Lindane production residues.

Waste Storage Area near Bishti Palles Cape

- 1989 to 1998 – Storage of residues from the Lindane production process including Carbon Disulfide, Sodium Dichromate, Methanol, Mono-Methylamine, Dimethylamine, Ethylenediamine, Trimethylamine, hexachlorocyclohexane (HCH) residue, Sulphur powder.

These economic activities left a heavy pollution burden in the area which is being addressed by on-going remediation projects financed by UNDP, the World Bank and international donors.

At present little economic activities are going on in the area. Nevertheless the national territorial plans for the area foresee Industrial and Energetic Development in the plots of the Project Site and south from it.

Oil and gas depots are present in the area and are mainly located within 1 km from the West Coast in the area between Bishti Palles Cape and Porto Romano.

A significant oil and gas storage is still in construction and includes a port infrastructure with loading-unloading system of oil products from oil tankers to the oil installations as well as a system of loading / unloading through tank-trucks. Its overall capacity is 24,000 m^3. The first phase of investment of about 14,000 m^3 is complete (5 reservoirs). The built area is about 29,100 m^2, whereas the total plot of land bought is 36,000 m^2 (www.riraoil.com).

Other activities present in the area include:

- Beach resort and restaurants, on the coast to the west of the site
- Restaurant on the coast to the north of the site
- Farms and pasture land.

One farm is located on the north-west border of the site, another three are located within 1 km from the site limit. The land inside the site area appeared uncultivated during field surveys.

5.11. PUBLIC HEALTH

5.11.1. *National Situation in Albania*

The national situation on Public Health has been assessed based on the report "*Highlights on Health in Albania, 2005*", published by the World Health Organization (WHO), and on the data supplied by the Institute of Statistics of Albania (INSTAT).

Highlights on Health in Albania by the WHO

This document gives an overview of Albania's health status, providing recent data on mortality, morbidity and exposure to key risk factors along with trends over time. The report also compares the country to reference groups, which comprise countries with similar health and socioeconomic trends or development and/or geopolitical groups.

Albania is ranked by the WHO within the group "Eur-B+C" which includes 25 countries with low child mortality and low or high adult mortality. Countries with very low child mortality are classified as "Eur A". This class includes 27 countries, most of which are the EU member states.

The public health framework is presented in the following paragraphs with reference to three epidemiological indicators:

- Life expectancy;
- Burden of Disease;
- Main causes of death.

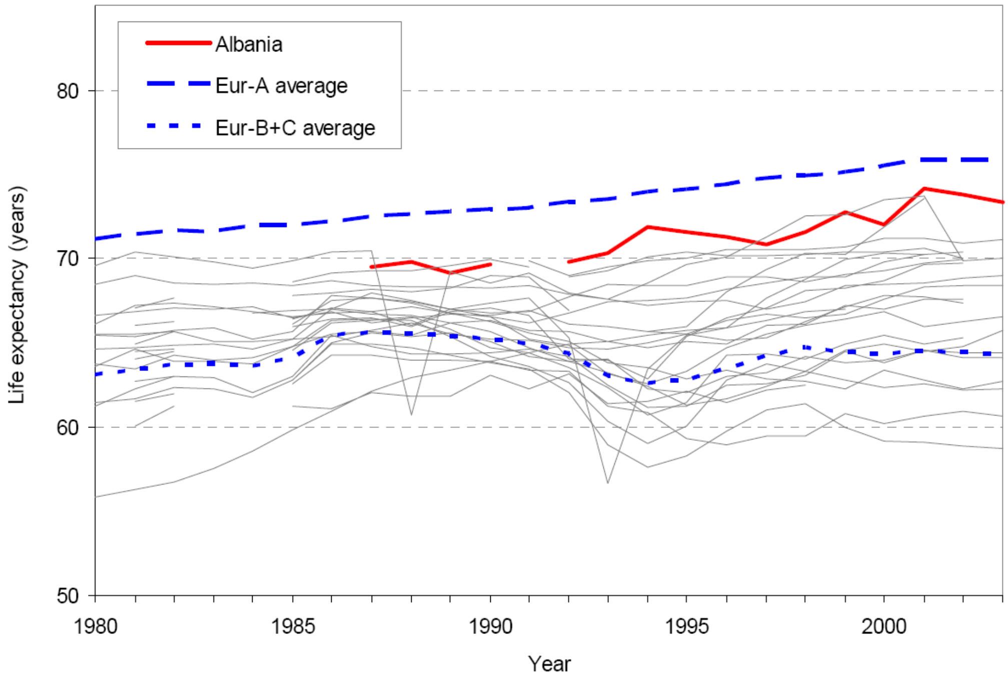
Life expectancy

According to the WHO estimates, a person born in Albania in 2002 could expect to live 70,4 years on average: 74,1 years for women and 67,3 years for men. This estimate is two years longer than the Eur-B+C average, but more than eight years shorter than the Eur-A average.

In 2002 the national mortality statistics, on which the official life expectancy (LE) figure is based, gave estimates six years higher at birth than the WHO estimate. Under-reporting of deaths and difficulties gathering population statistics most likely explain these differences.

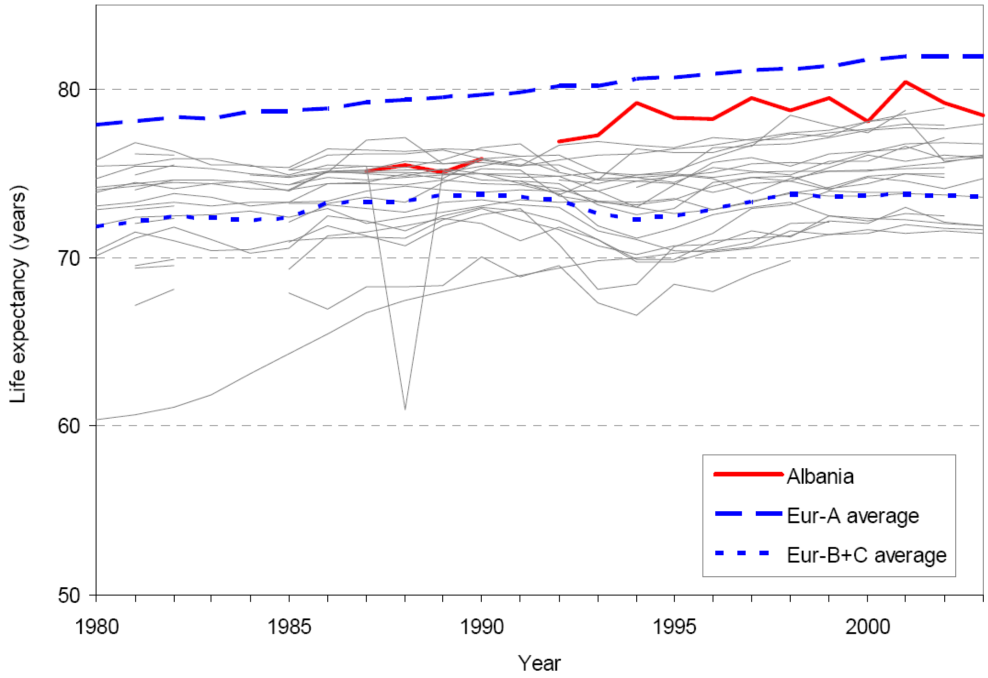
According to the national figures, the Albanian people gained about 3,6 years in life expectancy between 1987 and 2003. This gain was slightly greater for men (3,8 years) than women (3,3 years).

Figure 5.11.1a Life Expectancy at Birth for Males, 1980 to Latest Available Years



Source: Highlights on Health in Albania, 2005

Figure 5.11.1b Life Expectancy at Birth for Females, 1980 to Latest Available Years

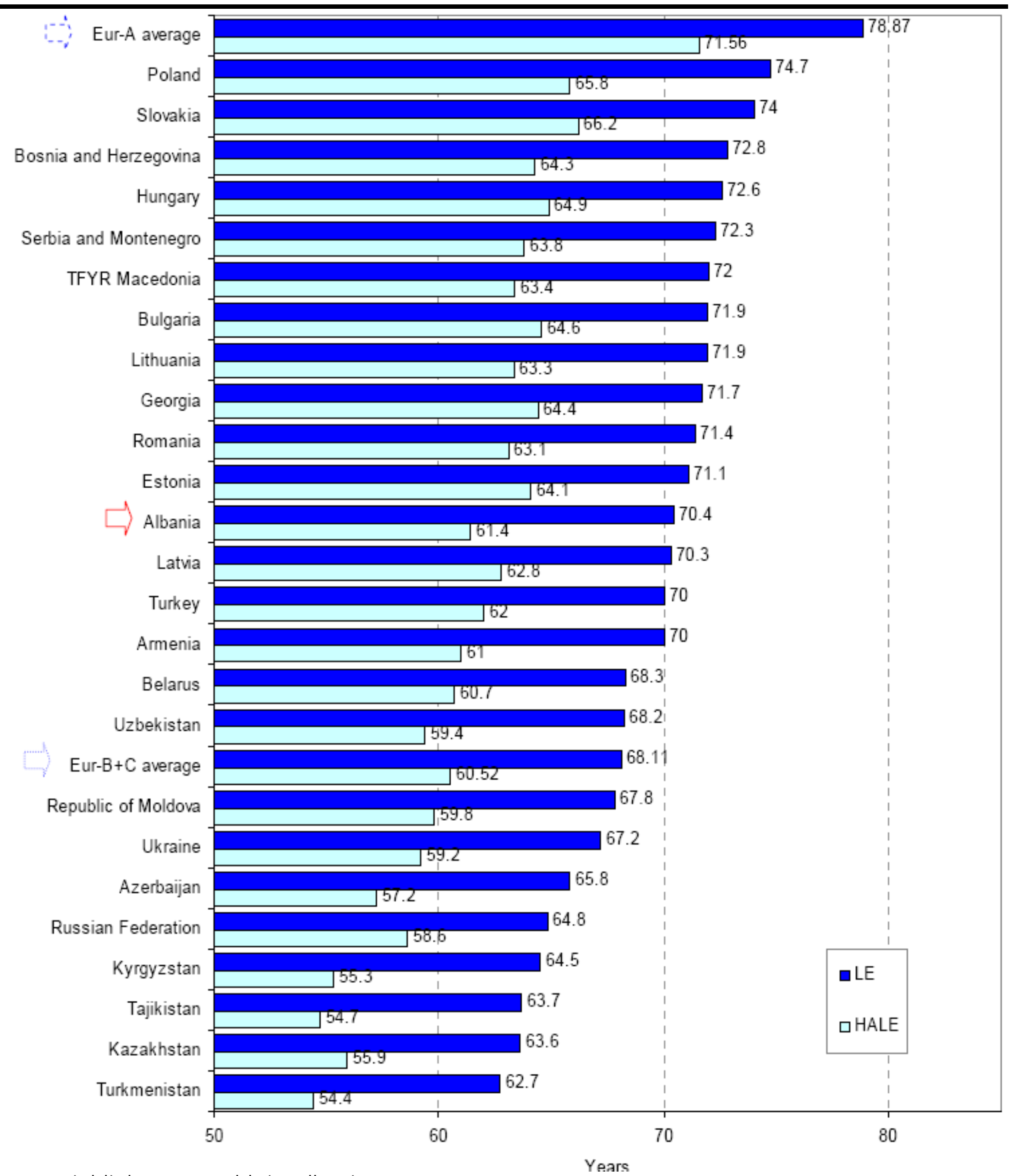


Source: Highlights on Health in Albania, 2005

In addition to life expectancy, it is increasingly important to know the expected length of life spent in good health. The WHO uses an indicator for this purpose, named healthy life expectancy (HALE), subtracting estimated years of life spent with illness and disability from estimated life expectancy.

For Albania, the WHO estimates that people can expect to be healthy for about 87% of their lives. They lose an average of 9 years to illness. This loss is larger than the Eur-A average (7,3 years) and the Eur-B+C average (7,6 years).

Figure 5.11.1c Life Expectancy (LE) and Healthy Life Expectancy (HALE), 2002



Source: Highlights on Health in Albania, 2005

Since women live longer and since the possibility of deteriorating health increases with age, women lose more healthy years of life (10,8 years) than men (7,8 years). Nevertheless, women in Albania have 3,8 more years of healthy life expectancy. Also among 60 year-old people, women live healthy more than three years longer compared to men (13,9 versus 10,5 years) according to the WHO estimates.

Burden of Disease

The burden of disease in a population can be viewed as the gap between current health status and an ideal situation in which everyone lives into old age, free of disease and disability. Causing the gap are premature mortality, disability and certain risk factors that contribute to illness. The analysis that follows elaborates on the burden of disease in the population. The disability-adjusted life-year (DALY) is a summary measure that combines the impact of illness, disability and mortality on population health.

Table 5.11.1a shows the top ten conditions, in descending order, that account for approximately 90% of the burden of disease among males and females in Albania. Unintentional injuries among males and cardiovascular diseases and neuropsychiatric conditions among both males and females account for the highest burden of disease. Because mortality from neuropsychiatric conditions is minor, disability in daily living comprises the bulk of their burden on the population's health.

Table 5.11.1a *Ten Leading Disability Groups as Percentages of Total DALYs for Both Sexes in Albania, 2002*

Males		Females	
Disability groups	Total DALYs (%)	Disability groups	Total DALYs (%)
Unintentional injuries	22,1	Neuropsychiatric conditions	24,1
Cardiovascular diseases	19,3	Cardiovascular diseases	19,6
Neuropsychiatric conditions	16,5	Malignant neoplasm	9,0
Malignant neoplasm	9,0	Unintentional injuries	7,0
Perinatal conditions	4,4	Musculoskeletal diseases	5,8
Respiratory infections	3,9	Sense organ diseases	4,3
Digestive diseases	3,7	Perinatal conditions	4,1
Musculoskeletal diseases	3,4	Respiratory infections	4,0
Sense organ diseases	3,1	Nutritional deficiencies	3,5
Intentional injuries	2,7	Digestive diseases	2,9

Source: Highlights on Health in Albania, 2005

Table 5.11.1b, instead, shows the top ten risk factors with their relative contributions, in descending order, to the burden of disease in the male and female populations of Albania. According to DALYs, tobacco, alcohol and high blood pressure comprise the greatest burden of disease on Albanian men, and high blood pressure and high BMI on women.

Table 5.11.1b *Ten Leading Risk Factors as Causes of Disease Burden Measured in DALYs in Albania, 2002*

Males		Females	
Disability groups	Total DALYs (%)	Disability groups	Total DALYs (%)
Tobacco	12,6	High blood pressure	7,2
Alcohol	10,4	High BMI	6,0
High blood pressure	7,7	Tobacco	4,9
High cholesterol	4,7	High cholesterol	4,0
High BMI	4,5	Low fruit-vegetable intake	2,2
Low fruit-vegetable intake	2,7	Physical inactivity	2,2
Physical inactivity	2,2	Unsafe sex	1,9
Occupational risk factors for injuries	1,8	Indoor smoke from solid fuels	1,6
Lead	1,4	Alcohol	1,5
Indoor smoke from solid fuels	1,4	Childhood and maternal underweight	1,4

Source: Highlights on Health in Albania, 2005

Main causes of death

In 2003, selected non-communicable diseases accounted for about 76% of all deaths in Albania, ill-defined conditions for about 13,5%, external causes for about 5% and communicable diseases for about 0,5%.

In total 52% of all deaths were caused by diseases of the circulatory system, 14% by cancer, 5% by respiratory diseases, 3% by neuropsychiatric disorders and 2% by digestive diseases.

Albanian people are at lower risk of dying from CVDs (cardiovascular diseases) than the Eur-B+C average, excluding women under 15 and men under 30. For children and adolescents, the excess risk for dying of CVDs is eight times the Eur-B+C average, and Albania, together with Turkmenistan, has the highest death rate in this age group. This may, however, be at least partly explained by differences in classification and registration of causes of death.

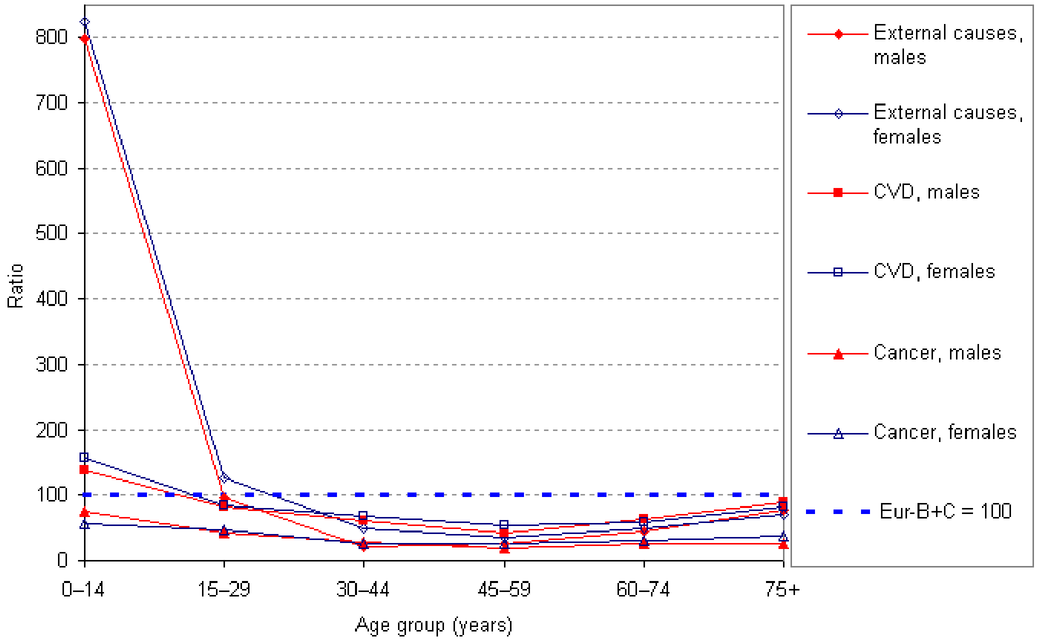
The risk for cancer death is lower for all men and women aged 15 years or more. According to these national figures, Albanians have also a low death risk for external causes and poisonings in all age groups and for both sexes compared to the Eur-B+C average.

Table 5.11.1c Selected Mortality in Albania 2003

Condition	SDR per 100000 Albania	SDR per 100000 Eur B+C average	Excess mortality in Albania (%)	Total deaths in Albania (%)	Total deaths in Eur B+C (%)	Eur A average	Excess Albania to Eur A (%)	Total deaths in Eur A (%)
Selected non-communicable conditions	646,5	1044,9	-38,1	76,3	79,6	533,8	21,1	82,4
Cardiovascular diseases	*439,8*	*741,8*	*-40,7*	*51,9*	*56,5*	*243,4*	*80,7*	*37,6*
Ischaemic heart diseases	127,8	362,7	-64,8	15,1	27,6	95,9	33,3	14,8
Cerebrovascular diseases	158,8	221,7	-28,4	18,7	16,9	61,1	159,9	9,4
Diseases of pulmonary circulation and other heart disease	106,2	68,9	54,1	12,5	5,3	56,6	87,6	8,7
Malignant neoplasms	*121,1*	*172,0*	*-29,6*	*14,3*	*13,1*	*181,5*	*-33,3*	*28,0*
Trachea/bronchus/lung	29,4	33,9	-13,3	3,5	2,6	37,1	-20,8	5,7
Female breast	11,3	22,1	-48,9	1,3	1,7	27,0	-58,1	4,2
Colon/rectal/anal	5,0	19,0	-73,7	0,6	1,4	20,7	-75,8	3,2
Prostate	16,7	14,3	16,8	2,0	1,1	25,1	-33,5	3,9
Respiratory diseases	*47,2*	*63,1*	*-25,2*	*5,6*	*4,8*	*47,8*	*-1,3*	*7,4*
Chronic lower respiratory diseases	18,1	31,2	-42,0	2,1	2,4	20,2	-10,4	3,1
Pneumonia	22,4	23,6	-5,1	2,6	1,8	16,2	38,3	2,5
Digestive diseases	*14,1*	*52,3*	*-73,0*	*1,7*	*4,0*	*30,8*	*-54,2*	*4,8*
Chronic liver disease and cirrhosis	0,0	32,0	-100,0	0,0	2,4	12,6	-100,0	1,9
Neuropsychiatric disorders	*24,2*	*15,7*	*54,1*	*2,9*	*1,2*	*30,3*	*-20,1*	*4,7*
Communicable conditions	**4,4**	**20,8**	**-78,8**	**0,5**	**1,6**	**8,4**	**-47,6**	**1,3**
AIDS/HIV	0,0	0,8	-100,0	0,0	0,1	1,1	-100,0	0,2
External causes	**43,0**	**139,6**	**-69,2**	**5,1**	**10,6**	**40,3**	**6,7**	**6,2**
Selected unintentional causes	*33,0*	*102,2*	*-67,7*	*3,9*	*7,8*	*28,7*	*15,0*	*4,4*
Motor vehicle traffic injuries	9,3	14,7	-36,7	1,1	1,1	9,9	-6,1	1,5
Falls	2,1	7,5	-72,0	0,2	0,6	6,1	-65,6	0,9
Selected intentional causes	*9,9*	*37,4*	*-73,5*	*1,2*	*2,9*	*11,6*	*-14,7*	*1,8*
Self-infliucted (suicide)	4,4	23,2	-81,0	0,5	1,8	10,6	-58,5	1,6
Violence (homicide)	5,5	14,2	-61,3	0,6	1,1	1,0	450,0	0,2
Ill-defined conditions	**114,2**	**64,0**	**78,4**	**13,5**	**4,9**	**20,9**	**446,4**	**3,2**
All causes	**847,2**	**1312,2**	**-35,4**	**100,0**	**100,0**	**647,8**	**30,8**	**100,0**

Source: Highlights on Health in Albania, 2005

Figure 5.11.1d Main Causes of Mortality by Sex and Age Group



Source: Highlights on Health in Albania, 2005

Cardiovascular diseases cause more than half of all deaths in Albania. The biggest single killers are cerebrovascular diseases (18,7% of all deaths in 2003), ischaemic heart diseases (15,1%) and diseases of pulmonary circulation and other heart diseases (12,5%).

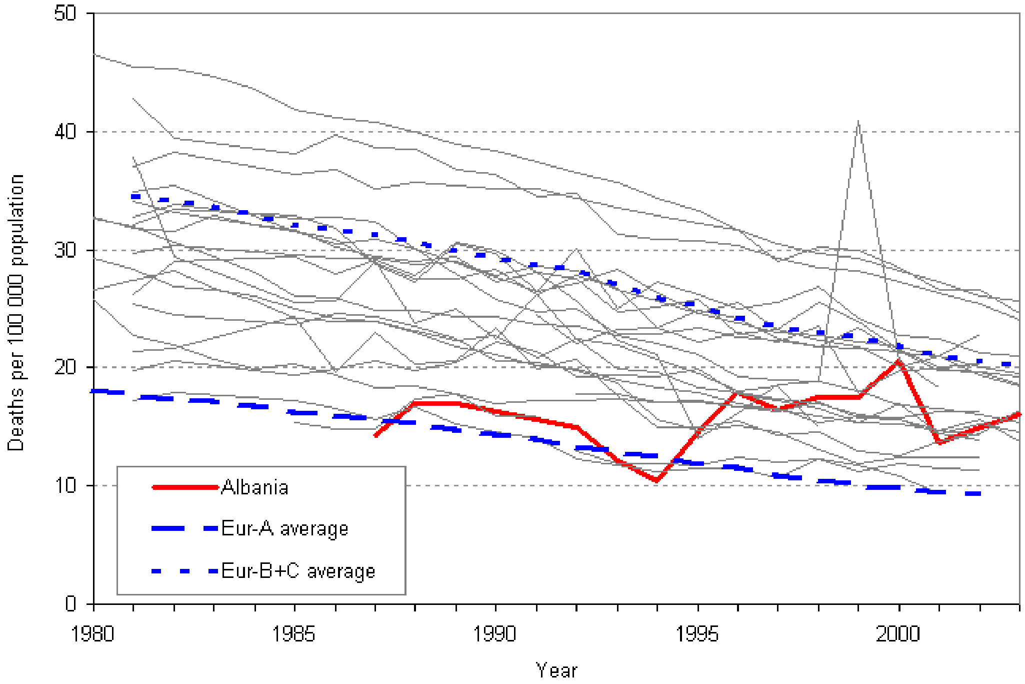
Mortality for cardiovascular diseases has increased both for the young and middle-aged (under 45 years old) and for the elderly (75 and over), while a declining trend can be observed in the remaining age groups. The development is similar for both sexes and for ischemic heart diseases and cerebrovascular diseases.

Cancer causes only every seventh death in Albania. Mortality below 30 years old persons is declining and following the Eur-B+C average. Males 30–74 years old also have declining death rates, significantly below the Eur-B+C average. Elderly males have an increasing risk for dying from cancer, equal to the Eur-B+C average. Female cancer death rates are increasing, but they are still below the Eur-B+C average.

As for general cancer mortality, cause-specific death rates in Albania are low compared to the Eur-B+C levels, and are either decreasing (lip cancer, bladder cancer, cancer of oesophagus, skin cancer, uterine and ovarian cancer) or stagnating (colorectal cancer and cancer of lymphoid and haematopoietic tissue).

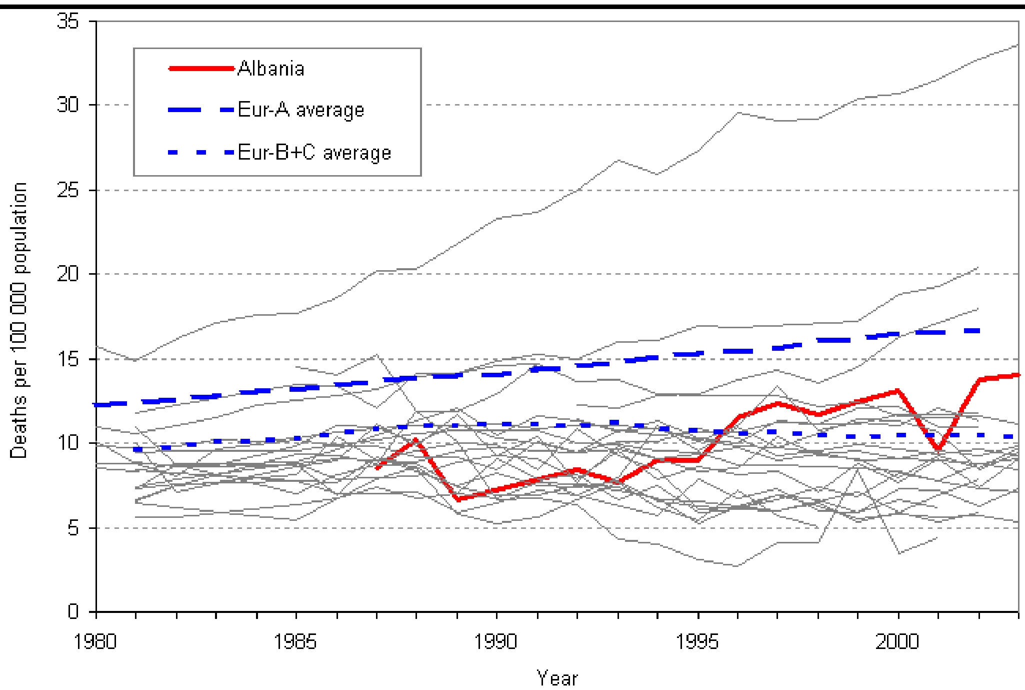
Mortality for cancers of the larynx, trachea, bronchia and lungs is different for men and women. For men, the death rate remains stable, and below the declining Eur-A and Eur-B+C averages. For women, it is increasing at the same rate as the Eur-A average and it has already passed the Eur-B+C average. These mortality patterns reflect the previous trends in smoking, which became more common in Albania between 1990 and 2000. According to the most current data, 60% of men and 18% of women 15 year old and over are regular daily smokers.

Figure 5.11.1e Standardized Death Rate for Stomach Cancer in People of all Ages, 1980 to Latest Available Year



Source: Highlights on Health in Albania, 2005

Figure 5.11.1f Standardized Death Rate for Larynx, Trachea, Bronchus and Lung Cancer in Females, all Ages, 1980 to Latest Available



Source: Highlights on Health in Albania, 2005

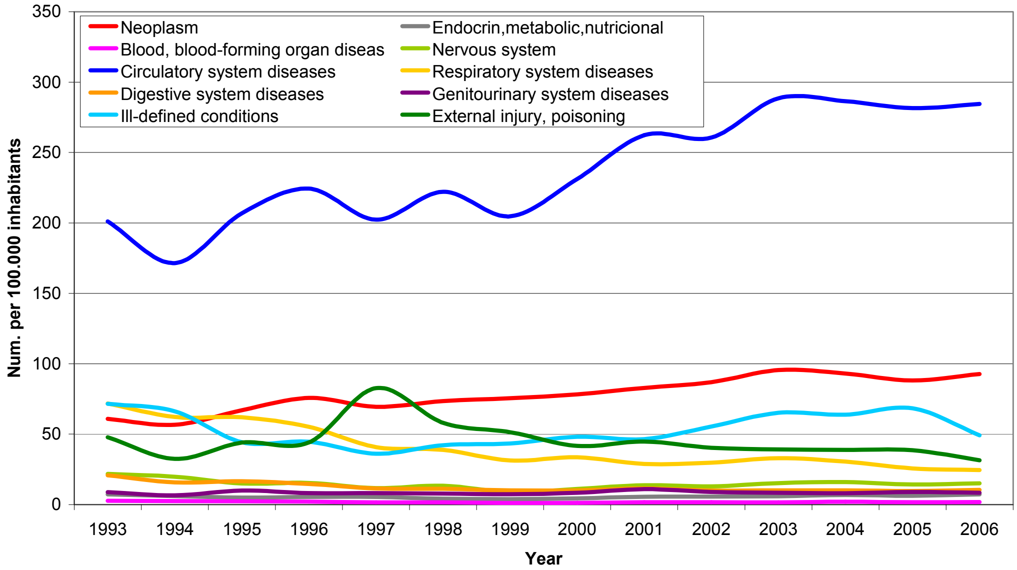
Institute of Statistics of Albania (INSTAT) Data

The health situation of Albania is studied by the Institute of Statistics of Albania (INSTAT) through statistical indicators.

The main indicators show a consistent trend of improvement both for the primary health care and the hospital services. The level of some important indicators such as lifetime, death and chronic diseases are comparable to those of the developed countries, while infantile death, maternal death and acute infective disease are comparable to those of the countries under development.

Statistics show that a relatively high number of deaths and diseases in Albania is the result of smoking, alcohol, imprudence on the streets, use of illegal drugs, food and stress as the new modern phenomenon of the society. Passive living is a risk factor as it presents a potential problem for hypertension, heart diseases, strokes etc.

Figure 5.11.1g Main Causes of Death by Group-Diseases



Source INSTAT

Table 5.11.1d *Causes of Death by Group-Diseases*

Cause of death	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Infectious and parasitic diseases	11,1	9,5	4,4	4,5	3,4	3	2,2	2	3	3	3	3,1	2,5	2,9
Neoplasm	60,8	56,6	67	75,8	69,5	73,5	75,5	78,3	82,8	86,9	95,5	93,1	88,1	92,7
Endocrin, metabolic, nutricional	7,2	6,1	4,9	5,5	5,5	4,1	3,8	4,5	5,5	5,7	5,9	6,8	6,3	7,2
Blood, blood-forming organ diseases	2,7	2,5	2,4	2	1,7	1,6	1,1	1,2	1,7	1,7	1,6	2	1,7	1,8
Mental disorders	3,4	3,4	2	1,9	1,9	2,6	1,9	1,9	3,7	2,6	2,6	3,4	3,7	4
Nervous system	21,7	19,7	15	15,4	11,6	13,5	8,8	11,1	13,8	12,9	15,3	16	14,2	15,1
Circulatory system diseases	201,1	171,5	206,9	224,4	202,4	222,2	204,7	231,2	262,4	260,7	288,5	286,4	281,5	284,5
Respiratory system diseases	71,8	62,2	62	55,3	40,8	38,8	31,3	33,5	28,9	29,7	32,9	30,5	25,7	24,5
Digestive system diseases	20,8	15,8	16,6	14,7	11,5	11,2	10,1	10,1	11,4	10	10,1	10,1	9,6	10,5
Genitourinary system diseases	8,8	6,5	9,9	8,1	8,1	7,8	7,4	8,4	11	9	8,3	8	9	8,4
Complication of pregnancy	0,5	0,3	0,3	0,2	0,2	0,2	0,1	0,3	0,2	0,2	0	0	0,2	0,2
Skin, tissue diseases	1,3	0,9	0,4	0,2	0,1	0,3	0,1	0,2	0,3	0,2	0,3	0,2	0,3	0,4
Bones, muscle system diseases	1,5	1,8	0,9	0,8	0,9	1,2	0,7	0,8	1,1	1,3	1,3	1,2	1,1	1,2
Congenital malformations	4,5	3,5	4,3	3,8	4,3	3,6	3,1	2,2	2	1,5	2	1,8	1,6	1,8
Certain diseases of early infancy	7,1	5,9	8,2	7,2	6,2	5,6	8	7,2	5,5	3,3	3	2,2	2,2	2
Ill-defined conditions	71,5	66,3	44,3	44,6	36,2	42,2	43,4	48,2	46,5	55,4	65,2	63,8	68,4	49,2
External injury, poisoning	47,8	32,5	44,1	44,1	82,8	58	51,4	41,6	44,8	40,3	39,2	38,9	38,6	31,5
Total	543,6	465,1	493,5	508,4	486,8	489,2	453,5	482,6	524,6	524,5	574,7	567,6	554,6	537,8

Source INSTAT

5.11.2. *Situation in Porto Romano*

Preamble

This section is based on the contents of the report "*Evaluation of the impact of environmental pollution on the health of inhabitants of Porto-Romano area*" published by the Ministry of Environment, Forests and Water Administration of Albania in 2005.

The presence in Porto Romano of the former industrial production of lindane and dichromate as well as of a plant for the production of sulphur-based chemicals and a dumpsite for chemicals and waste has caused serious degradation of the environment. The contamination is still in progress due to the migration of contaminants via the shallow groundwater, rainfall runoff and illegal transportation of contaminated soils. The site and its immediate surroundings impose severe risks to human health.

The Albanian Ministry of Environment has commissioned the Porto Romano Remediation Project, aimed at improving the environmental conditions by reducing pollution of soil and impacts on groundwater and significantly reducing human and environmental health hazards of the neighbouring population groups. The Project consists in the construction of a landfill, to contain the contaminated soil and demolition materials from the former industrial areas in Porto Romano, and of the relevant soil and demolition materials movement and transportation.

Based on the data on the levels of contamination, at present the major health risks for the local inhabitants are connected with:

- Consumption of water from local wells (officially prohibited but probably still occurring);
- Consumption of milk and meat from animals grazing on contaminated areas;
- Consumption of contaminated vegetables;
- Inhalation of airborne contaminated particles.

The report "*Evaluation of the impact of environmental pollution on the health of inhabitants of Porto-Romano area*" was produced with the aim to evaluate the effects of the contamination conditions on the health status of the inhabitants, to define recommendations for preventing further deterioration and to identify the needs for curing the affected people.

Size of the Sample and Methodology Used

The sample studied consisted of 200 people exposed to the industrial pollution, for variable periods of time; it has been divided into two big groups:

- The first group consisted of 100 students of primary school, mainly 13 years old, who underwent the test with the respective questionnaire as well as the subjective and neurological examination.
- The second group consisted of 100 adults without any preliminary selection, residents of Porto Romano community for an adequate period of time, in order to have health effects caused by the external pollution of the environment.

The questionnaire used for interviews included issues such as: level of education, working experience, socio-economic situation, smoking habits, health data of family members in particular for bronchitis, bronchial asthma pulmonary T.B.C. and other diseases.

The sample studied underwent some more detailed examinations, such as:

- Functional respiratory tests;
- Reflex assessments;
- E.E.G. with indication;
- Complete blood test with the leucocytes formula;
- Blood content of lindane;
- Abdominal Ultrasound Examination;
- Chromate content in the children's hair;
- Lindane content in milk;
- Six valences chrome content in wells' water.

Findings

The findings confirmed that many inhabitants of the Porto Romano community suffer from the consequences of environmental pollution.

The families' disease history confirms the presence of chronic pulmonary diseases. These were also confirmed by the examination of the dynamic pulmonary functions: almost 50% of the surveyed people had abnormal values. Respiratory symptoms (cough, dyspnoea and chest pain) were present both in adults and children of this community. According to the study the smoking prevalence in the area is low, and this could suggest a potential correlation among the local pollution and the respiratory symptoms.

The harmful effect of the chemical pollutants is reportedly evident in the gastro-intestinal tract, on the skin and mucosa, in the nasal cavity and neurological system. The symptom "abdominal pain" was present in 37% of the cases; in over 20% this symptom was associated with vomit or nausea. Skin damages, that were associated to the effects of chromates, were detected in 12% of cases and epistaxes among 11% of the surveyed adults. This could be connected to long term exposure of inhabitants. Skin irritation and epistaxes were also present among children with respective percentages of 14,29% and 18,37% of the surveyed.

The asteno-vegetative syndrome (headache, sleep disorders, anxiety, muscle tremor), was also reported. Potential effects of environmental pollution on the vegetative nervous system were evidenced by reflex assessment assays.

The blood pressure was found altered (hypo and hypertension) in 55% of the surveyed people. Rather than with environmental exposure, this would be linked with chronic cardio-vascular impairments, feeding patterns, age, stress.

The overall conclusion of the mentioned report is that the findings confirmed that many inhabitants of the Porto Romano community suffer from the consequences of environmental pollution, and this would apply in particular to the inhabitants of the immediate surroundings of the former industrial facilities.

The analysis of HCH isomers in blood revealed concentration of alpha and beta HCH above international standards, whereas gamma and delta isomers were undetectable.

The examinations of water wells showed a high concentration of Chrome VI compounds. Therefore the report recommended that the water from the wells should not be used as drinking water for the residents nor for the livestock. On the other hand the examinations of water samples from the water pipe revealed no Chromate content.

The content of HCH isomers in cow milk were also above international safety standards. For this reason the report recommended that the consumption of milk from the area should be prohibited.

According to the same report further scientific studies would be needed to verify children morbidity and chromosomal changes.

No specific data is reported about cancer incidence in the area.

5.11.3. *References*

INSTAT (2004). Living Condition and Inequality in Albania.

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6

6. IMPACTS ASSESMENT

6.1. AIR

This paragraph analyses the impacts on air quality deriving from the realization of *Porto Romano Power Plant*, considering both the construction and the operation phase.

Impacts related to two Scenarios: the first with one 800 MWe unit and the second with two 800 MWe units. These are compared with the European and Albanian limit values.

6.1.1. *Construction phase*

The main potential impact on air quality During the construction phase is to dust suspension, caused by the civil works related to the construction of the new installations.

The area of the construction site is approximately 787,000 m^2.

In general, during the construction phase, dust emissions derive from the following activities:

- pulverization and abrasion of surfaces, caused by trucks carrying soil and materials;
- dragging of dust particles caused by wind erosion of pile surfaces;
- mechanical action on incoherent materials and excavations with excavators, bulldozers, etc…;
- involuntary transport of mud thrust by trucks wheels the can produce dust when dried out.

An indicative assessment of dust production and related impacts was performed using the methodology described below.

6.1.1.1. *Dust Emission*

During the realization of the planned works, the dust is produced mainly by materials handling in yard arrangement, excavations, top-benching and aggregate transport.

The quantity of dust produced is proportional to the volume of the handled material. The excavations necessary to realize the new plant will move a quantity of soil equal to about 2,000,000 m^3, of which about 400,000 m^3 derive from the topsoil removal.

Considering a specific gravity of soil equal to 1.7 t/m^3, the quantity of handled soil will be 3,400,000 t.

This value is used to evaluate dust production through a standard emission factor proposed by EPA for yard activities equal to 0.02 kg/t.

The following *Table 6.1.1.1a* shows the assessment of dust emission related to all the yard activities.

Table 6.1.1.1a Total Dust Emission in the Yard

Activity	Emission Factor [kg/t]	Material Handled [t]	Dust Emission [t]
Trucks loading	0.02	680,000	13.6
Trucks unloading	0.02	3,400,000	68
		Total	81.6

The trucks loading takes into account only the topsoil removal in the yard area (about 400,000 m^3), since the remaining part (about 1,600,000 m^3) will be supplied elsewhere.

The total emission of dust deriving from yard activities is estimated is 81.6t.

This value does not include dust re-suspension due to wind that appreciably increases the dust concentration in the atmosphere.

The parameters to be considered in the evaluation of wind erosion, are: exposed surface, exposure time and specific emission factor for dust resuspension, which according to EPA guidelines is equal to 0.85 t/ha per year.

Table 6.1.1.1b shows the factors and calculated values for dust emission due to re-suspension.

Table 6.1.1.1b Dust Emission due to Wind Resuspension

Activity	Emission Factor [t/ha*y]	Exposed Surface [ha]	Exposure Time [years]	Dust Emission [t]
Wind Erosion	0.85	78.7	0.83	55.75

The wind erosion in the yard, during the 10 months to complete the works, produces about 55.75 t of dust.

On the whole, the dust deriving from yard activities is about 137.35 t. Assuming 260 workdays (6 workdays per week), the daily SPM (Suspended Particulate Matter) production is about 528.3 kg/day.

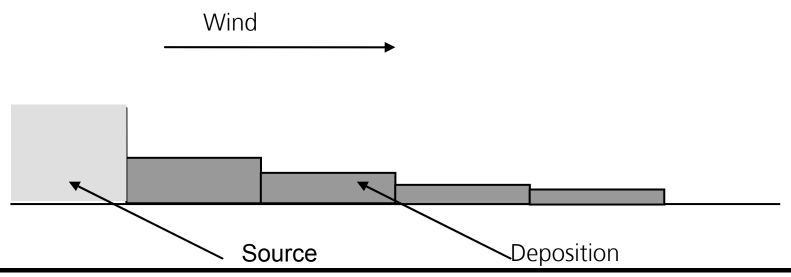
6.1.1.2. *Dust Deposition Rate Assessment at Receptors*

The estimation of the dust deposition rate at different distances from the construction yard mainly depends on the combination of the two following factors: meteorological conditions and type of activity carried out. The evaluation is subject to numerous uncertainties.

Technical norms suggest the use of parametric calculations that allow to specify the order of magnitude of expected deposition.

The selected model assesses the particles fraction that settles at various distances from the source (*Figure 6.1.1.2a*).

Figure 6.1.1.2a Dust Deposition Model



This model calculates a deposition factor downwind of the source based on the above-mentioned emissions load (528.3 kg/day).

It is assumed that the dust flow is equally distributed on a vertical rectangular surface, one meter wide and of parametrically variable height.

In addition it is assumed that the dust deposition in the wind direction, is only function of the distance from the source and that the lateral dispersion of dust is negligible.

The selected impacts evaluation method provides an assessment of the maximum concentrations downwind from the yard, in critical meteorological conditions. The wind speed is assumed to be equal to 2 m/s, therefore the previously estimated specific emission factor is independent from the wind speed and is adopted as average conditions.

In real terms changes in wind speed can modify dust dispersion, in that low speed reduces the impacted area and increases dust deposition near the yard and the opposite situation occurs with high wind speed.

In order to evaluate dust distribution it is assumed that the total emissions are divided into a linear front, orthogonal to wind direction, that depends on the yard dimensions, not necessarily in a linear way. The emission front is conservatively assumed to be the square root of the whole yard technical areas surface.

In terms of emission length, it would be necessary to calculate, depending on wind direction, the transversal dimension of the yard, and then to hypothesize the emission distribution inside this length. Since this dimension is unknown, even because of its different shapes during the life of the yard, a reproducible approach is preferred; in this way there is the advantage of providing a direct and sure indication of critical situations in every single yard.

Other things being equal, a smaller area involves a bigger deposition rate (due to a bigger emission per unit surface area).

It is assumed that emissions take place at variable heights from the ground, between 0 and 5 meters. Ground dust deposition levels are estimated starting from gravimetric settlement velocity. Conservatively, it is assumed that dust does not spread orthogonally to wind direction.

The deposition speed depends on particles size. Particles larger than 30 μm settle in any case close to the yard. Therefore the first 100 meters belt around the yard is considered significantly impacted, independently from any numerical calculation.

The settlement velocity of medium size particles (assumed to be of a spherical form, density of 2,000 kg/m^3 and diameter of 10 to 30 μm), ranges between 1.25 and 3.3 cm/s.

By considering the above-mentioned velocity, it is possible to calculate the deposition distance as a function of wind speed and emission height; these distances are (for particles emitted at 5 meters from the ground with a 2 m/s wind):

- 10 μm particles: 800 meters downwind;
- 20 μm particles: 550 meters downwind;
- 30 μm particles: 300 meters downwind.

Dust deposition at different distances from the yard is then calculated depending on the formerly exposed hypothesis, according to the following formula:

$$D_{<100m} = relevant$$

$$D_{100-300} = \frac{0.10 \cdot F.E.}{300L} + \frac{0.10 \cdot F.E.}{550L} + \frac{0.10 \cdot F.E.}{800L}$$

$$D_{300-550} = \frac{0.10 \cdot F.E.}{550L} + \frac{0.10 \cdot F.E.}{800L}$$

$$D_{550-800} = \frac{0.10 \cdot F.E.}{800L}$$

where:

- D_{xx} is the deposition (in g/m^2·day) inside the distance bands indicated in m by the subscript index "$_{xx}$";
- *L* is the yard length; it is equal to 200 (meters) for mobile yards and to $A^{0,5}$ for set yards (technical areas included), where A is the yard surface in m^2;
- *F.E.* is the total dust emission (in g/day)

The impact of dust deposition is assessed by comparing the gravimetric deposition rate with the values reported in the Conclusive Report of the work group of the "*Central Commission against Atmospheric Pollution*" of the Italian Ministry of the Environment. This method allows to classify an area based on the dust indexes shown in *Table 6.1.1.2a*.

Table 6.1.1.2a Dusting Classes Depending on Deposition Rate

Dusting Classes	Total Dust Potentially Settled (mg/m^{2}day)	Dusting Index
I	< 100	Practically Absent
II	100 – 250	Low
III	251 - 500	Medium
IV	501 - 600	Medium – High
V	> 600	High

The evaluation results obtained on the basis of the above mentioned considerations and hypothesis are shown in *Table 6.1.1.2b.*

Table 6.1.1.2b Yard Activities Impact

Typology	Area (m^2)	Distance from Yard (m)	Deposition ($mg/m^2 \cdot day$)	Impact
Yard	787,000	< 100	n.d.*	High
		100 - 300	380	Medium
		300 – 550	182	Low
		550 – 800	74	Practically Absent

** not calculate, it is assumed – a priori – an high deposition.*

As shown in the *Table* above, the impact due to the deposition of airborne particles, deriving from yard activities, is defined "practically absent" at distances above 550 m from the source.

It should be underlined that this evaluation method does not take into account mitigation measures aimed at reducing dust emissions from the construction yard.

The adopted approach is absolutely conservative and the values obtained represent the maximum deposition that can occur downwind from the yard, and not the average one in a fixed point.

Given the above mentioned results, dust depositions at the settlements of Rina, the closest inhabited area 1,000 m from the yard, are considered "Practically absent".

6.1.2. *Operational Phase*

This paragraph describes the evaluation of ground concentrations of macro-pollutant (SO_2, NO_2, SPM) that will be produced during operation of the *Porto Romano Power Plant*.

6.1.2.1. *CALPUFF Characteristics*

The modelling system CALMET-CALPUFF, adopted by U.S. EPA and described in Appendix A of the "*Guideline on Air Quality Models*", was developed by *Sigma Research Corporation*, now part of Earth Tech. Inc., with the support of *California Air Resources Board* (CARB).

In order perform the simulations, CALMET-CALPUFF modelling system (version 5.8) was used, as recommended by US-EPA since 06/29/2007 (http://www.epa.gov/scram001/dispersion_prefrec.htm#calpuff).

The modelling system is primarily constituted of the following three models:

- the meteorological pre-processor CALMET: produces the three-dimensional fields of wind and temperature within the modelling domain;
- the processor CALPUFF: dispersion model that introduces emissions in the wind field generated by CALMET and studies their transport and dispersion;
- the post-processor CALPOST: analyses statistically CALPUFF output data and produces sets of data suitable for further analysis.

CALMET is a diagnostic meteorological pre-processor, that can reproduce three-dimensional fields of wind and temperature along with two-dimensional fields of other parameters that are descriptive of the atmospheric turbulence. It is

appropriate to simulate the wind field in complex orography domains characterized by different typologies of land use.

The wind field is reconstructed by subsequent steps starting from an initial wind field that is often derived by geostrophic wind. In order for the wind field to take into account orography, the model interpolates the monitoring station values and applies specific algorithms that simulate the interaction between ground and flow lines.

CALMET contains in addition a micro-meteorological module that determines thermal and mechanical structure (turbulence) of lower atmospheric layers.

CALPUFF is an hybrid dispersion model (commonly defined 'puff model'). It is a multi-layer and non-steady-state model. It simulates transport, dispersion, transformation and deposition of pollutants, in meteorological conditions that change in space and time. CALPUFF employs the meteorological fields produced by CALMET, but for simple simulations an external wind field, homogeneous in the domain can be used as input.

CALPUFF contains different algorithms to simulate different factors, such as:

- buildings downwash and stack-tip downwash;
- wind vertical shear;
- dry and wet deposition;
- atmospheric chemical transformations;
- complex orography and seaboard.

Buildings downwash phenomenon is caused by the turbulence induced by wind power on obstacles. This factor can be very important because the eddies that draw the plume down can increase ground concentrations of pollutants. In order to simulate the buildings hydrodynamic influence on the plume, the model uses corrective factors that modify dispersion and plume rise parameters.

Numerous wind tunnel experiments accurately showed the perturbation that occurs in the presence of buildings. The vertical profile of average wind speed, upwind a parallelepiped-shaped building, normally shows a typical nearly logarithmic trend with altitude.

A building with two faces of the parallelepiped perpendicular to the average wind direction, generates:

- a stagnation point about two-thirds the way up the face of the upstream building;
- separated recirculation zones on the roof and sides;
- a turbulent wake cavity zone behind the structure that is important because plumes caught in the cavity can be quickly mixed to the ground;
- a turbulent wake where the unperturbed flow is restored.

In marine coastal areas, CALPUFF considers breeze phenomena in order to model efficiently the *Thermal Internal Boundary Layer* (TIBL). In case of coastal sources, the TIBL causes a quick fall of pollutants to the ground.

In order to better simulate the real conditions of the emission, CALPUFF allows to adjust the geometry of the source (point, linear or areal). Point sources simulate emissions limited to a small area; linear sources simulate emissions that are distributed along a main direction; areal sources describe an diffuse emission on a wider area.

CALPOST analyses CALPUFF output data and produces results that are suitable for further elaborations.

CALPOST output files can be fed into graphic softwares to create concentration or deposition maps.

The code requires the following input data:

- surface and upper air meteorological data to construct the three-dimensional wind field (with CALMET);
- source and emission data to simulate the dispersion of the pollutants in the air (with CALPUFF).

Outputs of CALPUFF code, elaborated by CALPOST, consist in matrices of concentration values. The receptors where impacts are assessed can be discrete or gridded. The values calculated at each receptor could be referred to one or more sources.

The results can be processed by any GIS software, creating isoconcentration maps like those presented in the *Paragraph 6.1.2.5.*

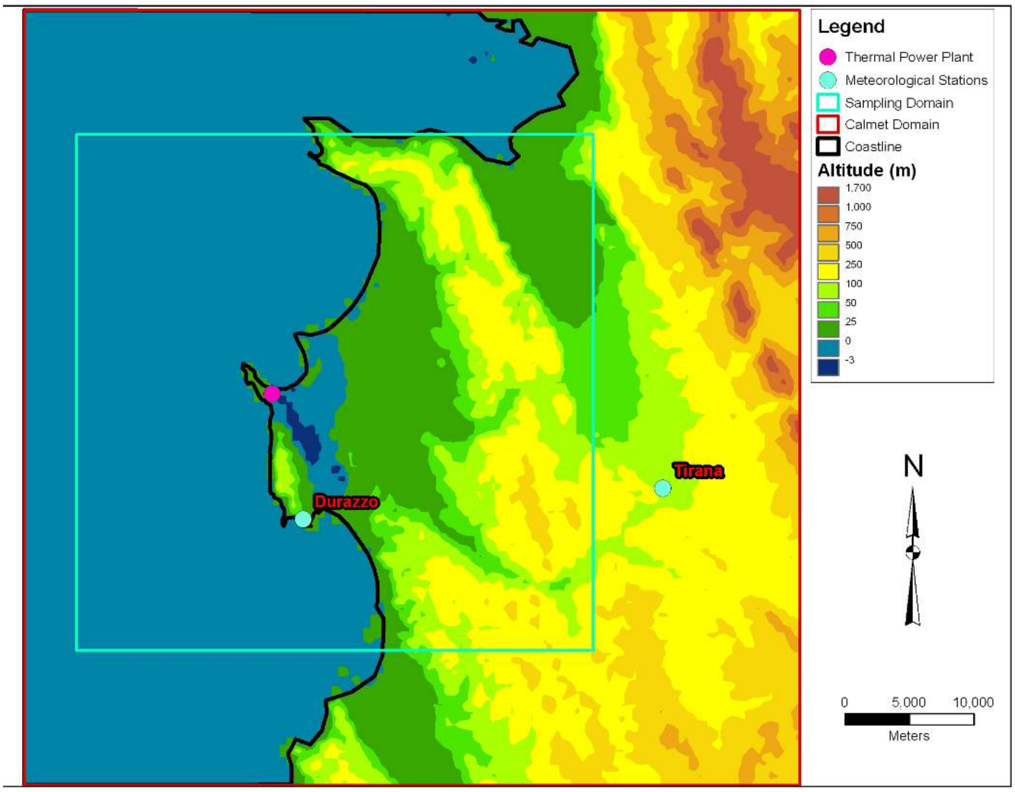
6.1.2.2. *Modelling Domain*

The meteorological grid where the wind field is constructed is 60 km long and 60 km wide with a 500 m resolution and it is north-oriented.

The sampling grid is a subset of the meteorological one and it is 40 km long and 40 km wide with a 500 m resolution.

Both domains are represented in *Figure 6.1.2.2a*, which also shows the location of the *Power Plant* and meteorological stations.

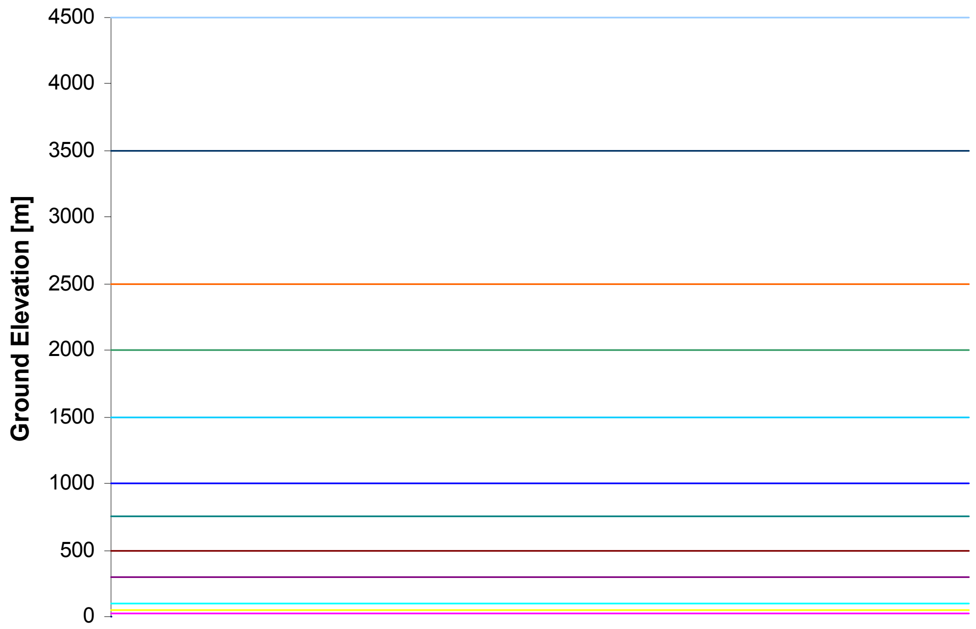
Figure 6.1.2.2a Domains and Meteorological Stations



The vertical resolution is defined by 12 layers, from 0 to 4,500 m elevation.

In order to better describe the meteorology of the near-ground atmosphere (Planetary Boundary Layer, PBL), that is the mostly influenced by the orography, the vertical layers resolution is higher in low elevation layers (see *Figure 6.1.2.2b*).

Figure 6.1.2.2b Vertical Layers in CALMET



CALMET requires an accurate geophysical characterization of the meteorological domain. In particular it needs site specific information about:

- Orography;
- Land Use.

Land Cover data were downloaded from the Global Land Cover Facility internet site (http://glcf.umiacs.umd.edu/data), whereas the orography of the area was reproduced with the Digital Elevation Model provide by USGS (United States Geological Survey).

6.1.2.3. *Meteorological Data*

The meteorological pre-processor CALMET requires hourly characterization of the surface atmospheric data.

The construction of the wind field and the following simulations of pollutant dispersion was carried out employing the meteorological data of the whole year 2007.

In particular the following average hourly values are required for each hour of simulation:

- Wind speed and wind direction;
- Temperature;
- Atmospheric pressure;
- Relative humidity;
- Clouds cover and ceiling height.

Meteorological data for Porto Romano area very scarce. The only station close to the *Power Plant* is situated in Durrës , as shown in *Figure 6.1.2.2a*, and it is managed by the Institute of Energy, Water and Environment. The station only provides three values of measurements per day.

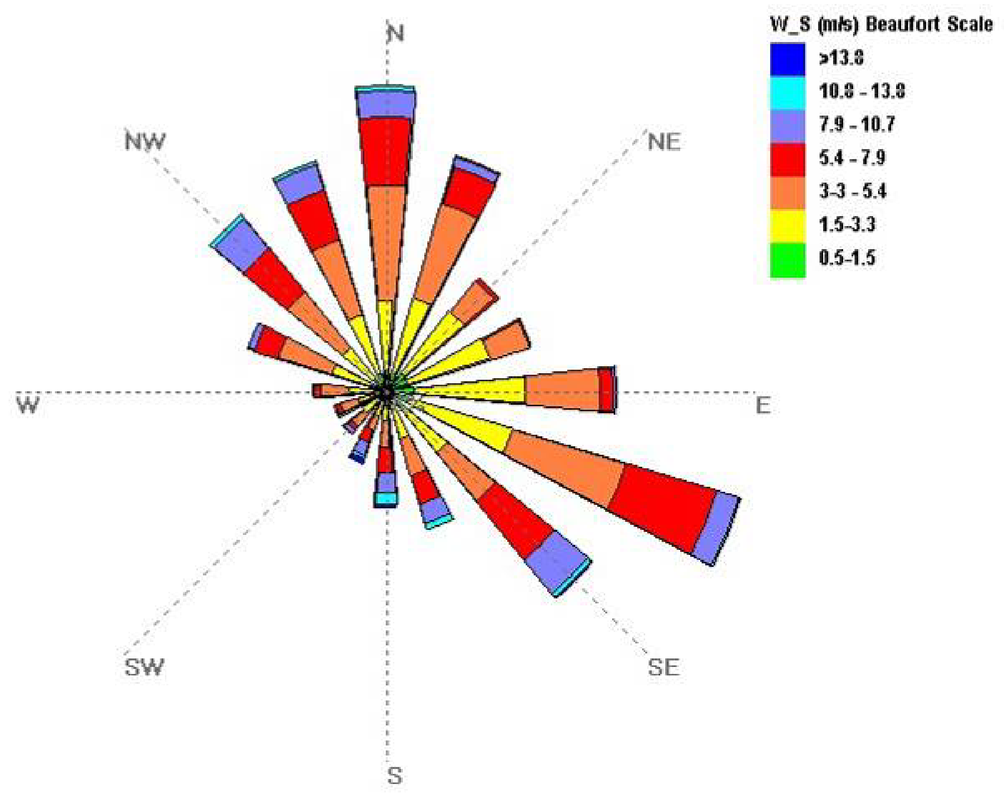
In order to complete the data set, meteorological data measured at Tirana airport were supplied by the *National Climatic Data Centre* (http://www.ncdc.noaa.gov/oa/ncdc.html), that is an international credited agency qualified to supply this typology of meteorological variables.

In order to carry out three-dimensional simulations, the model requires upper air data (pressure, temperature, wind speed and wind direction) at least every 12 hours, to characterize the wind regime and the atmosphere diffusive parameters (stability class, mixing height, thermal inversion, …).

Since in the investigated area radiosondes are not available, the necessary data were purchased from the Italian ARPA Emilia Romagna -Hydrometeorological Service. This agency, in fact, daily runs a local meteorological model, called LAMI (Limited Area Model Italy), whose domain includes Albania. LAMI is the Italian implementation of the non-hydrostatic limited area model named *Lokal Modell* (*Steppeler* 2003). It has an horizontal resolution of 7 km, and it is run twice a day at ARPA-SIM.

The following *Figure 6.1.2.3a* shows the wind rose extracted from CALMET model at the *Power Plant* site.

Figure 6.1.2.3a Wind Rose on Power Plant Site, Year 2007



6.1.2.4. *Emissions Scenarios*

In order to evaluate the emissions for both configurations of the power plant, two scenarios were simulated:

- *Scenario 1*: one 800 MWe unit;
- *Scenario 2*: two 800 MWe units.

For SO_2 and NO_x only stack emissions have been considered, whereas for SPM (Suspended Particulate Matter) also the emissions from coal handling and storage systems were evaluated.

Stack emissions have been simulated through a point source whose characteristics are reported in *Table 6.1.2.4a*. Both stacks in the *Scenario 2* have equal geometry and emission rates and they are about 100 m far from each other.

Table 6.1.2.4a Stack Point Source

Stack characteristics		
Height	m	150
Diameter	m	7,5
Temperature	°C	48
Velocity	m/s	18
Flue-gas capacity(1)	Nm^3/h	2,400,000
NOx Flue-gas concentration(1)	mg/Nm^3	150
NOx Emission rate(2)	t/h	0.36
SO_2 Flue-gas concentration(1)	mg/Nm^3	150
SO_2 Emission rate(2)	t/h	0.36
SPM Flue-gas concentration(1)	mg/Nm^3	10
SPM Emission rate(2)	t/h	0.024

(1) *dry at 6% O_2*
(2) *Estimate value based on design flue gas rate equal to 2,400,000 Nm^3/h*

The emission rates simulated comply with to the best available techniques (BAT) for the combustion of coal and lignite, as defined in the BREF document on Large Combustion Plants for new plants (paragraphs 4.5.6, 4.5.8 and 4.5.9).

The diffuse emissions of dust deriving from coal handling and storage have been simulated through areal sources, as shown in *Figure 6.1.2.4a*.

In order to analyse the diffuse emissions of *Porto Romano Power Plant* the possible sources of dust have been divided in two categories:

- wind erosion of pile surfaces;
- dropping operations.

Both categories refer to an emission factor assessment methodology of US EPA AP42.

The general equation for emissions estimation proposed by EPA AP42 is:

$E = A \times EF \times (1-ER/100)$

where:

- *E* = emission;
- *A* = activity rate (material handled or area exposed to wind erosion);
- *EF* = emission factor;

- *ER* = overall emission reduction efficiency (for example the watering of piles to reduce wind erosion).

The two emission factors (*EF*), one for each source category, have been calculated through the equations proposed in the EPA AP42 documents (chapter 13, paragraph 13.2.5 "*Industrial wind erosion*" and paragraph 13.2.4 "*Aggregate handling and storage piles*").

In order to calculate the SPM emission rates of areal sources related to coal handling, the assumption was that the coal flow inside the power plant corresponds to the coal burning capacity, equal to 243 t/h in the *Scenario 1* and to 486 t/h in the *Scenario 2*.

Regarding dust emissions associated to pier operations, coal unloading from the barges to the conveyor stacker, the assessment of the SPM emission rate is based on a coal unloading capacity of 10,000 t/d.

In compliance with the modelling requirements, this value is widely overestimated; in fact, by assuming a 24 hours working of the *Power Plant*, burning 243 t/h (in the *Scenario 1*), the daily coal demand is only 5832 t/d. In the *Scenario 2* all the values are doubled.

The SPM emission rates from wind erosion of the piles in the two stock areas, respectively for coal and for limestone, have been evaluated by taking into account the dimensions of each pile and the quantity of stocked material (220,000 t of coal and 6,000 t of limestone stocked).

Dust emissions of areal sources, named *CSA* and *LSA,* are formed by wind erosion of piles surface and drop operations of stacker and reclaimer machines.

Tables 6.1.2.4b, c report SPM emission rates for the areal sources considered in the two *Scenarios*.

Table 6.1.2.4b Scenario 1. Areal Sources

Source	Location	SPM Emission rate kg/h
PNT	pier	3.20E-02
CT1	first coal tower	4.67E-03
CSAa	coal stock area	1.41E-01
CT3	third coal tower	4.67E-03
B1	bunker 1	3.73E-04
LSA	limestone stock area	3.30E-02
CMH	crushing and milling house	1.72E-04

Table 6.1.2.4c Scenario 2. Areal Sources

Source	Location	SPM Emission rate kg/h
PNT	pier	6.40E-02
CT1	first coal tower	9.33E-03
CSAb	coal stock area	2.81E-01
CT3	third coal tower	9.33E-03
B1	bunker 1	3.73E-04
B2	bunker 2	3.73E-04
LSA	limestone stock area	3.98E-02
CMH	crushing and milling house	3.44E-04

6.1.2.5. *Impacts*

This paragraph describes the results of the simulations, carried out according to the above-mentioned method, in terms of ground concentrations of SO_2, NO_2 and SPM.

Results are illustrated through isoconcentration maps for each statistical index indicated in the *Directive 1999/30/EC* and in the Albanian Law *AL DCM no 803/2003*. The 40 x 40km modelling domain shown in the maps is centred on the *Power Plant* (Sampling Grid) and includes the Rrushkull protected area.

Both European and Albanian standards define limits for SO_2, NO_2 and PM_{10}, whereas the pollutants emitted by the *Power Plant* are SO_2, NO_x and SPM.

Since the main problem in the urban air of Durrës is the high concentration of particulate, it has been decided, conservatively, to compare SPM concentrations with PM_{10} limits.

NO_2 makes up to 70% of the total NO_x emitted by the Power Plant (*Vilà-Guerau de Arellano,Talmon et al., 1990, Atmospheric Environment*), therefore the output of the model was scaled to obtain NO_2 ground concentrations to compare them with the European and Albanian limits.

The maps that illustrate simulations results are the following:

- *Figure 6.1.2.5a*: Scenario 1 - SO_2 Annual Average Concentration [µg/m^3];
- *Figure 6.1.2.5b*: Scenario 1 - SO_2 99,7° Percentile of Hourly Average Concentrations [µg/m^3];
- *Figure 6.1.2.5c*: Scenario 1 - SO_2 99,2° Percentile of Daily Average Concentrations [µg/m^3];
- *Figure 6.1.2.5d*: Scenario 1 - SO_2 Maximum Hourly Average Concentration [µg/m^3];
- *Figure 6.1.2.5e*: Scenario 1 - SO_2 Maximum Daily Average Concentration [µg/m^3];
- *Figure 6.1.2.5f*: Scenario 1 - NO_2 Annual Average Concentration [µg/m^3];
- *Figure 6.1.2.5g*: Scenario 1 - NO_2 99,8° Percentile of Hourly Average Concentrations [µg/m^3];
- *Figure 6.1.2.5h*: Scenario 1 - NO_2 Maximum Hourly Average Concentration [µg/m^3];
- *Figure 6.1.2.5i*: Scenario 1 - NO_2 Maximum 4-Hours Average Concentration [µg/m^3];
- *Figure 6.1.2.5j*: Scenario 1 - SPM Annual Average Concentration [µg/m^3];
- *Figure 6.1.2.5k*: Scenario 1 - SPM 90,4° Percentile of Hourly Average Concentrations [µg/m^3];
- *Figure 6.1.2.5l*: Scenario 1 - SPM Maximum Daily Average Concentration [µg/m^3];
- *Figure 6.1.2.5m*: Scenario 2 - SO_2 Annual Average Concentration [µg/m^3];
- *Figure 6.1.2.5n*: Scenario 2- SO_2 99,7° Percentile of Hourly Average Concentrations [µg/m^3];
- *Figure 6.1.2.5o*: Scenario 2 - SO_2 99,2° Percentile of Daily Average Concentrations [µg/m^3];

- *Figure 6.1.2.5p*: Scenario 2 - SO_2 Maximum Hourly Average Concentration [µg/m^3];
- *Figure 6.1.2.5q*: Scenario 2 - SO_2 Maximum Daily Average Concentration [µg/m^3];
- *Figure 6.1.2.5r*: Scenario 2 - NO_2 Annual Average Concentration [µg/m^3];
- *Figure 6.1.2.5s*: Scenario 2 - NO_2 99,8° Percentile of Hourly Average Concentrations [µg/m^3];
- *Figure 6.1.2.5t*: Scenario 2 - NO_2 Maximum Hourly Average Concentration [µg/m^3];
- *Figure 6.1.2.5u* Scenario 2 - NO_2 Maximum 4-Hours Average Concentration [µg/m^3];
- *Figure 6.1.2.5v* Scenario 2 - SPM Annual Average Concentration [µg/m^3];
- *Figure 6.1.2.5w*: Scenario 2 - SPM 90,4° Percentile of Hourly Average Concentrations [µg/m^3];
- *Figure 6.1.2.5x*: Scenario 2 - SPM Maximum Daily Average Concentration [µg/m^3].

The following *Table 6.1.2.5a* shows the maximum ground concentrations in the modelling domain for all the considered pollutants.

Table 6.1.2.5a Maximum Ground Concentrations in the Sampling Grid

Parameter	Scenario 1 [µg/m³]	Scenario 2 [µg/m³]	AL DCM no 803 Limit [µg/m³]	1999/30/CE Limit [µg/m³]
SO_2 Annual Average	0.76	1.51	*35*	*20*(3)
SO_2 99,7° percentile(1)	38.76	80.23	-	*350*
SO_2 99,2° percentile(2)	7.98	15.83	-	*125*
SO_2 Max hourly Average	163.25	307.53	*360*	*500*(5)
SO_2 Max daily Average	10.84	22.1	*120*	-
NO_2 Annual Average	0.53	1.06	*60*	*40*
NO_2 99,8° percentile(1)	30.57	60.97	-	*200*
NO_2 Max hourly Average	114.28	215.27	*250*	-
NO_2 Max 4-hours average	41.72	83.81	*95*	*400*(5)
SPM Annual Average	0.75	1.16	*60*(4)	*40*(4)
SPM 90,4° percentile(2)	1.56	2.37	-	*50*(4)
SPM Max daily Average	2.53	4.05	*150*(4)	-

(1) *1 hour averaging time*
(2) *1 day averaging time*
(3) *limit for ecosystem protection*
(4) *related to* PM_{10}
(5) *measured over three consecutive hours*

Table 6.1.2.5b shows the pollutants' statistical indexes, as defined by *Directive 1999/30/ECI* and *AL DCM no 803*, extracted from the model (time series of ground concentrations) at Durrës air quality station. The estimated values are compared with applicable limits.

Table 6.1.2.5b *Concentrations Estimated by CALPUFF at Durrës Air Quality Station*

Parameter	Scenario 1 [µg/m³]	Scenario 2 [µg/m³]	AL DCM no 803 Limit [µg/m³]	1999/30/CE Limit [µg/m³]
SO_2 Annual Average	0.39	0.77	*35*	*20*[(3)]
SO_2 99,7° percentile[(1)]	15.15	28.68	-	*350*
SO_2 99,2° percentile[(2)]	2.68	5.01	-	*125*
SO_2 Max hourly Average	86.61	154.97	*360*	*500*[(5)]
SO_2 Max daily Average	4.33	7.74	*120*	-
NO_2 Annual Average	0.27	0.54	*60*	*40*
NO_2 99,8° percentile[(1)]	11.37	22.17	-	*200*
NO_2 Max hourly Average	60.63	108.48	*250*	-
NO_2 Max 4-hours average	18.14	32.43	*95*	*400*[(5)]
SPM Annual Average	0.03	0.06	*60*[(4)]	*40*[(4)]
SPM 90,4° percentile[(2)]	0.09	0.16	-	*50*[(4)]
SPM Max daily Average	0.29	0.52	*150*[(4)]	-

(1) 1 hour averaging time
(2) 1 day averaging time
(3) limit for ecosystem protection
(4) related to PM_{10}
(5) measured over three consecutive hours

6.1.3. *Conclusions*

During the construction phase beyond 550 meters of distance from the yard, the dust index is *Practically Absent*, i.e. the dust potentially settled is lower than 100 mg/m^2day.

The ground concentrations produced by *Porto Romano Power Plant* operation are always below the European and Albanian law limits and will be compatible with the actual state of air quality.

As shown in the isoconcentration maps the bigger impact occurs southeast from the site, consistently with the wind rose in *Figure 6.1.2.3a*, that shows wind trends at the *Power Plant* site.

As shown in *Paragraph 5.1.2.2*, concentrations of Suspended Particulate Matter recorded at Durrës air quality station, exceed European and Albanian limits, while SPM ground concentration induced by Power Plant operation will not be significant. In fact, the maximum values of SPM annual average concentrations are three orders of magnitude lower than the regulatory limits for PM_{10} and $PM_{2,5}$ limits (see *Table 5.1.2.1b*).

6.2. SOIL

6.2.1. *Construction Phase*

The construction of the thermal power plant produces impacts on soils and subsoils mainly due to:

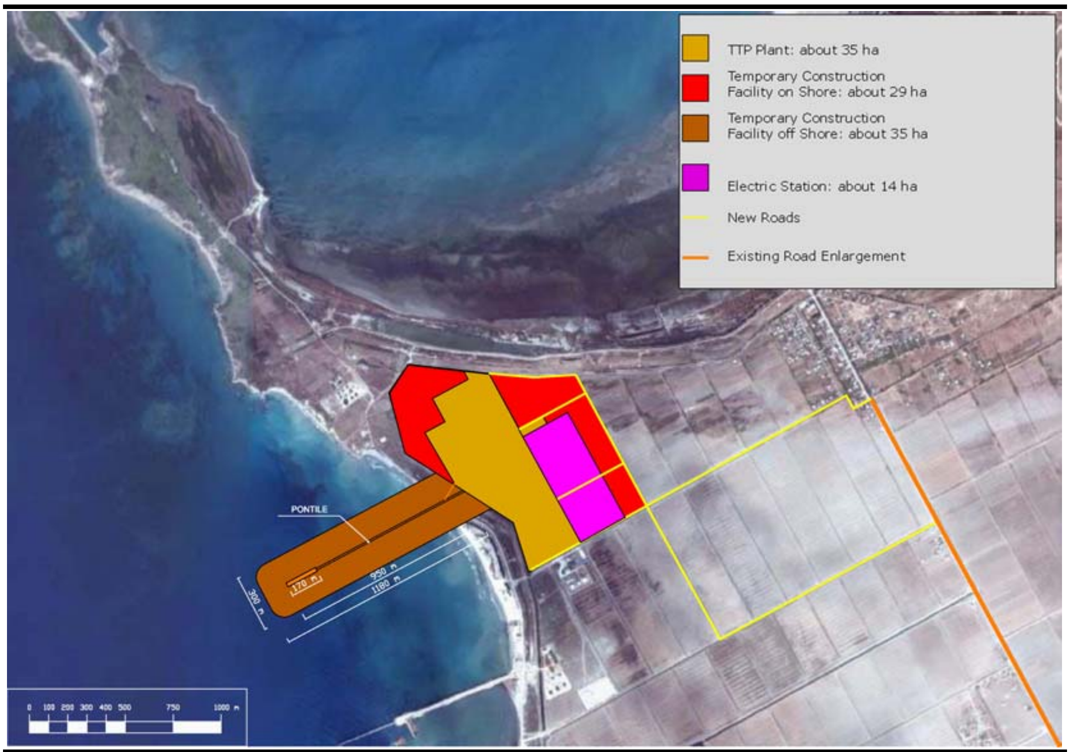
- Topsoil removal and deep excavation;
- Subtraction of land to local uses.

6.2.1.1. *Phase 1*

The Thermal Power Plant in Phase 1 configuration will occupy an area of about 36 ha, while the electric station coupled with a conversion AC/DC Station will occupy an area of about 14 ha. Therefore, at the end of the first phase, the overall area occupied by the project will be about 50 ha.

Moreover, during construction phase, an area of about 29 ha, adjacent to the TPP fence, is needed for temporary construction and pre assembly purpose. During construction phase also the area dedicated to the Post Combustion Carbon Capture and Segregation Plant will be used (about 5 ha). The surface required during construction activities for materials lay-down, pre-assembly and offices will be about 30 – 35 ha. *Figure 6.2.1.1a* shows the area occupied during the first unit construction phase.

Figure 6.2.1.1a Soil Occupation - Construction Phase 1



The main activities having impacts on soil and subsoil during the construction phase will be:

- Top Soil Removal on the entire area of the site: about 0.50 m deep. The removed soil will be used for subsequent landscaping after the Power Plant has been completed;
- Deep Excavations: they will be carried out in the area where shallow floating foundations will be used. The depth of the excavations will range from 2.00 to 4.00 meters below the ground level;
- Power Island Foundations: large and deep shaft concrete piles will be drilled on site;

* Foundations other than power island: floating foundations will be used for minor buildings and machineries made of hollow box-shaped caissons. The height of these caissons ranges from 3 to 6 meters and will be partially buried in the soil. The free areas between floating foundations will be backfilled with compacted material in order to have a unique elevation of 3 meters above ground level for access roads and paved areas;
* Site Embankment: an embankment with compacted material will be laid on the site to achieve a final level of 3 m. a.s.l. in the operation area and 1.0-1.5 m a.s.l. in the construction yard.

As far as land subtraction to local uses is concerned, the site preparation will not have a relevant impact. The site area is only partially used for agricultural practices and grazing. The main cultivation is maize. Such activities are not intensive but poorly extensive, satisfying local needs. Moreover the site area is located under the sea level and in particular in winter the area can be considered as a wetland or marsh, as testified by the presence of Salicornia (a typical plant of humid and brackish environments). To avoid flooding problems, the canal network will be re-designed and site protection structures will be put in place.

All the above mentioned activities are temporary and only the land use modification can lead to permanent changes in the local environment.

6.2.1.2. *Phase 2*

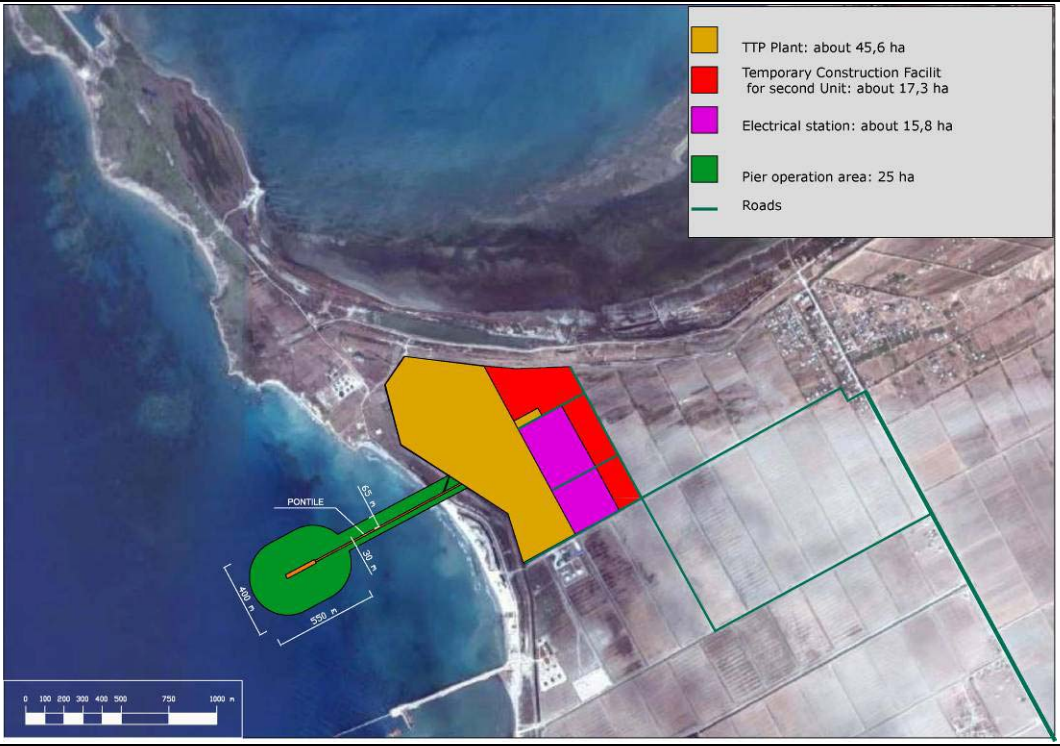
As described in *Figure 6.2.1.2a*, during Phase 2 configuration the Thermal Power Plant will occupy an area of about 47 ha, while the construction yard will be about 17 ha wide.

The main activities having impacts on soil and subsoil during this construction phase will be:

* Deep Excavations: they will be carried out in the area where shallow floating foundations will be used. The depth of the excavations will range from 2.00 to 4.00 meters below the ground level;
* Power Island Foundations: large and deep shaft concrete piles will be drilled on site;
* Foundations other than the power island's: floating foundations will be used for minor buildings and machineries made of hollow box-shaped caissons. The height of these caissons ranges from 3 to 6 meters and will be partially buried in the soil. The free areas between floating foundations will be backfilled with compacted material in order to have a unique elevation of 3 meters above ground level for access roads and paved areas.

As for Construction Phase 1, the impacts on soil and subsoil will be not relevant in this phase; all the above mentioned activities are temporary and only the land use modification can lead to permanent changes in the local environment

Figure 6.2.1.2a Soil Occupation - Construction Phase 2



6.2.2. *Operation Phase*

All the storage areas (chemical tanks, light oil and heavy fuel oil tanks, ashes silos area, limestone storage area, gypsum storage, waste water storage areas, lubricant oil storages) will be equipped with containment basins characterized by adequate capacity avoiding soil contamination.

The main impacts on soil will be related to soil subtraction.

The area occupied by the Power Plant will be about 35,6 ha during Phase 1 operation and about 46,6 ha during Phase 2 operation..

Considering the characteristics of the occupied areas, as previously described, the impacts on soil will be not significant.

6.3. SURFACE WATER AND GROUNDWATER

Impacts on surface waters and groundwater can be related to:

- *Construction Phase*: excavation activities performed to prepare the site and build the plant;
- *Operational Phase:* impacts due to the thermal discharge in the sea water and to the sewage system.

6.3.1. *Construction Phase*

6.3.1.1. *Groundwater*

The main significant aspect during construction phase is connected to the foundations. Due to groundwater depth (close to the surface) water table temporary lowering could be required, by means of a well point system. The well point risers will be driven and removed in order to anticipate the excavation sequence.

The main impact on groundwater quality during construction phase could be connected to the site sewage system. Nevertheless, taking into account that:

- the site is located in an area characterized by the presence of a low productive sandy aquifer (not representing a water supply source for the local population) having mainly poor quality water;
- potable and industrial water supplies needs during construction phase will be covered by temporary desalination plants;
- a sewage treatment plant will be installed for construction site domestic waste water;

the impacts on the groundwater system can be considered not significant, in terms of physical setting and quality.

6.3.1.2. *Surface Water*

The area of interest is not characterized by the presence of perennial flowing rivers, but a complex canal network has been set up to avoid flooding.

The main impacts on surface water can be summarized as follows:

- impacts on sea water quality and sediments from erosion and leaching of waste;
- release of sludge, used oil, hydraulic fluid, paint, solvents and other similar materials;
- impacts on sea water generated by ship traffic used to transport materials;
- impacts on floods frequencies (above all in winter) due to the modification of the canal network.

Nevertheless, considering that:

- all necessary security procedures will be applied and potential impacts on sea water quality due to occasional spills or releases will be minimized;
- the increase of sea water turbidity will be temporary;
- in order to maintain the efficiency of the canal network in preventing floods, the canal network will be re-designed around the site area;

the impacts on surface water can be considered not significant.

6.3.2. *Operational Phase*

6.3.2.1. *Groundwater*

No impacts are expected on groundwater due to the following considerations:

- Containment systems and paved surfaces are foreseen where the storage areas are planned;
- Systems to collect storm water are planned.

6.3.2.2. *Surface Water*

Two main impacts can be related to the following aspects:

- Water Thermal Discharge;
- Make Up Water take and Waste Water Discharge.

Water Thermal Discharge

The cooling water from Porto Romano Power Plant is discharged into the sea by means of a rectangular and divergent channel. The channel is designed for a cooling water capacity required for a power plant of 1600 MW.

The discharge channel is about 150 m long and reaches the reef with an angle of 10°. The slope of the final portion of the channel bottom starts from an elevation of –1.0 m and the dredged level ends at –1.5 m with reference to the mean sea level.

The design layout of the intake system includes an annular intake of gates submerged into the sea at - 8.0 m of depth. The central intake point is located at 1.0 km from the shoreline.

By means of a 3D Numerical Model (3D hydrostatic finite volume simulator CFD), water thermal discharge has been evaluated considering two different scenarios: one for 1 Unit operation (discharge 26.5 m^3/s at $\Delta T = 8°C$) and the other for 2 Units operation (discharge 53 m^3/s at $\Delta T = 8°C$). Five situations were analysed, corresponding to winter and summer ambient conditions:

- 1 Unit operation. Analysed cases:
  - Case PRBM0WI4, characterized by mean sea level, low current value (0.02 m/s), winter season conditions of water temperature and salinity (13.85°C and 38%), discharge angle of 10°, current direction from SSE, Directional wind component SE and wind velocity equal to 2.00 m/s;
  - Case PRBM0WI5, characterized by mean sea level, low current value (0.02 m/s), winter season conditions of water temperature and salinity (13.85°C and 38%), discharge angle of 10°, current direction from SSE, Directional wind component NNW and wind velocity equal to 3.90 m/s;
- 2 Units operation. Analysed cases:
  - Case PRAM0WI1, characterized by mean sea level, low current value (0.02 m/s), winter season conditions of water temperature and salinity (13.85°C and 38%), discharge angle of 10°, current direction from SSE, directional wind component SE and wind velocity equal to 2.00 m/s;

- Case PRAM1SI2, characterized by mean sea level, mean current value (0.08 m/s), summer season conditions of water temperature and salinity (23.5°C and 38.34%), discharge angle of 10°, current direction from SSE, directional wind component NNW and wind velocity equal to 3.55 m/s;
- Case PRAM0WI3, characterized by mean sea level, low current value (0.02 m/s), winter season conditions of water temperature and salinity (13.85°C and 38%), discharge angle of 10°, current direction from SSE, directional wind component NNW and wind velocity equal to 3.90 m/s.

For 1 Unit operation the analyses have been carried out considering only the ambient situation which typically occurs in winter. In such situation, the buoyancy of the hot water is less than in summer, so the depth of the plume is larger and, as a consequence, there are more possibilities of recirculation.

The results of the mathematical model (as reported in the following *Figures*) show that:

- in all scenarios, even though there is a downstream propagation of the thermal plume, it is very unlikely that hot water can be captured by the intakes;
- for both current velocities, the thermal plume deepens far away from the outlets and is confined to a depth no larger than 3.0 m;
- in all cases, even though there is a propagation of the thermal plume, the isotherm less than + 3°C is always located in the boundary of the mixing zone (zone where initial mixing and dilution take place), as required by the Minister of Environment, with Decision No. 177 dated 31.03.2005, and by World Bank Group in the Guidelines "*Pollution Prevention and Abatement Handbook, 1998*".

Figure 6.3.2.2a　　*Case PRBM0WI4 – Q = 26.5 m^3/s*

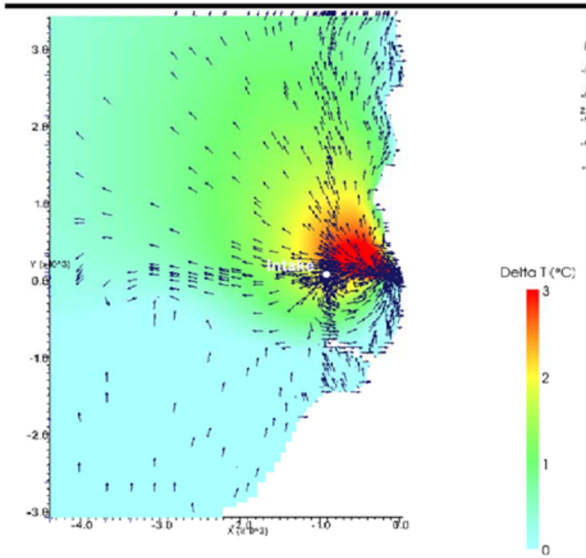


Figure 1 - Thermal map and Velocity field

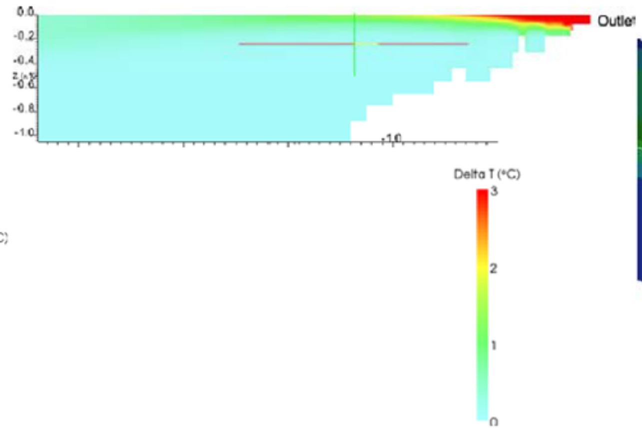


Figure 2 - Buoyant spreading processes downstream at the outlet. The thermal plume remains confined to a depth not larger than 1.5 m

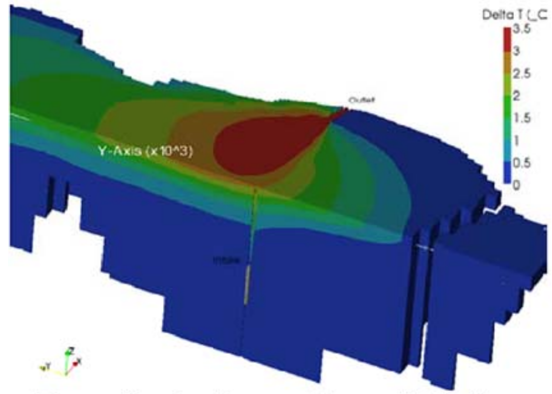


Figure 3 – Isothermal lines. ΔT in the vertical section at the intake point

Figure 6.3.2.2b Case PRBM0WI5 – Q = 26.5 m^3/s

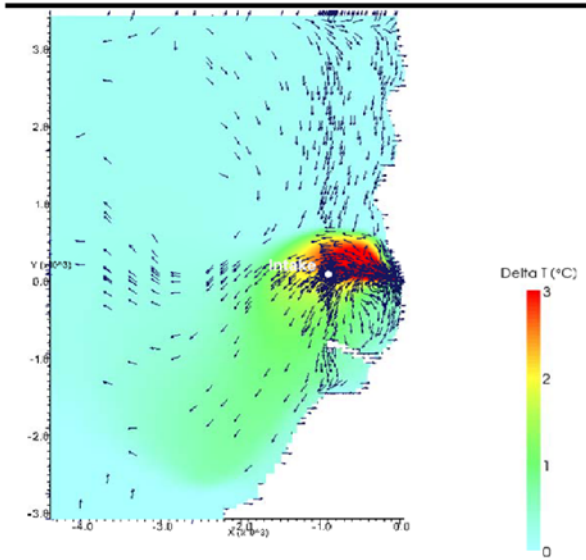


Figure 1 - Thermal map and Velocity field

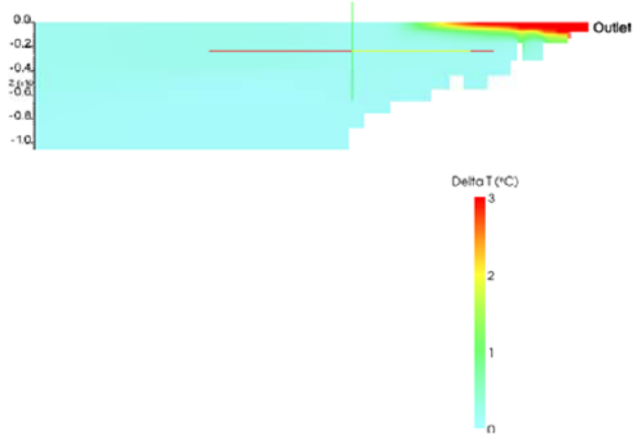


Figure 2 - Buoyant spreading processes downstream at the outlet. The thermal plume remains confined to a depth not larger than 1.5 m

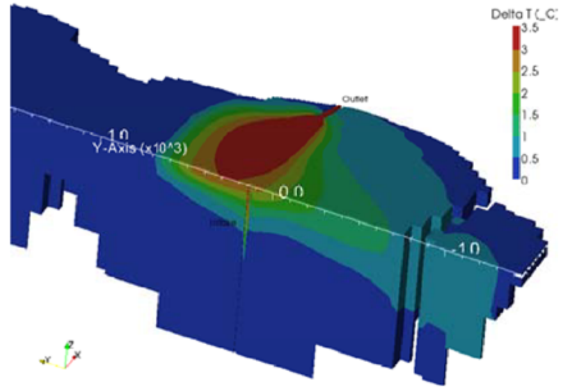


Figure 3 – Isothermal lines. ΔT in the vertical section at the intake point

Figure 6.3.2.2c   Case PRAM0WI1 – Q = 53 m3/s

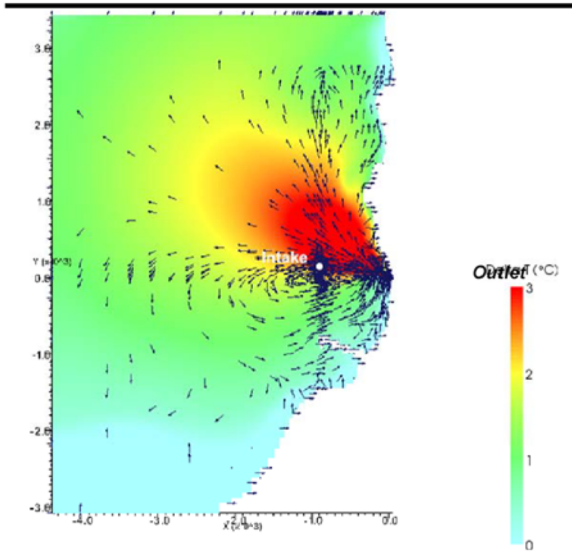


Figure 1 - Thermal map and Velocity field

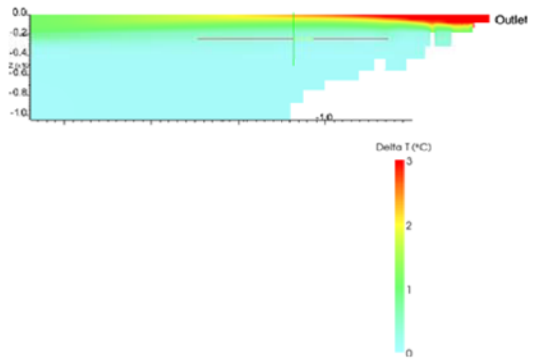


Figure 2 – Buoyant spreading processes downstream at the outlet. The thermal plume remains confined to a depth not larger than 2.0 m

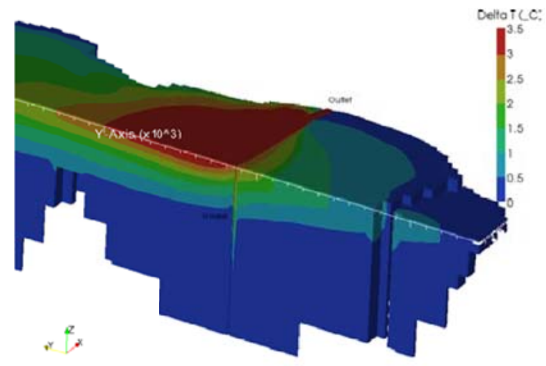


Figure 3 – Isothermal lines. ΔT in the vertical section at the intake point

Figure 6.3.2.2d Case PRAM1SI2 – Q = 53 m3/s

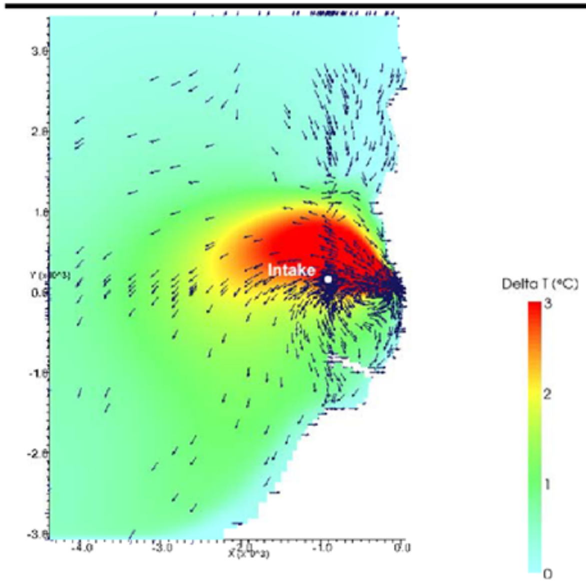


Figure 1 - Thermal map and Velocity field

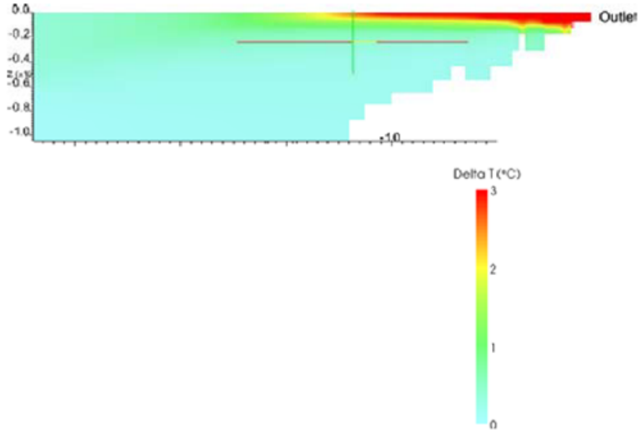


Figure 2 - Buoyant spreading processes downstream at the outlet. The thermal plume remains confined to a depth not larger than 2.0 m

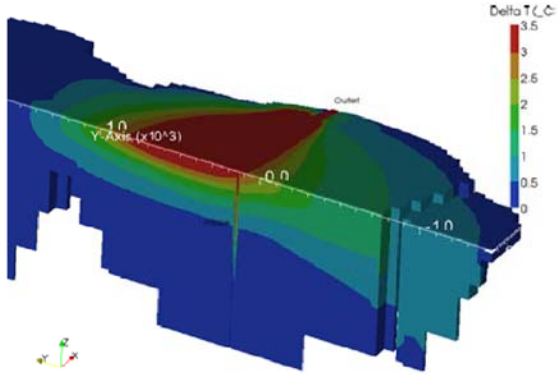


Figure 3 – Isothermal lines. ΔT in the vertical section at the intake point

Figure 6.3.2.2e Case PRAM0WI3 – Q = 53 m^3/s

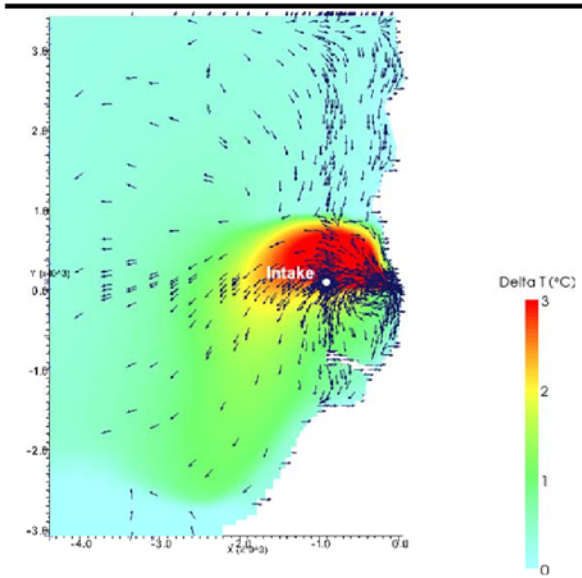


Figure 1 - Thermal map and Velocity field

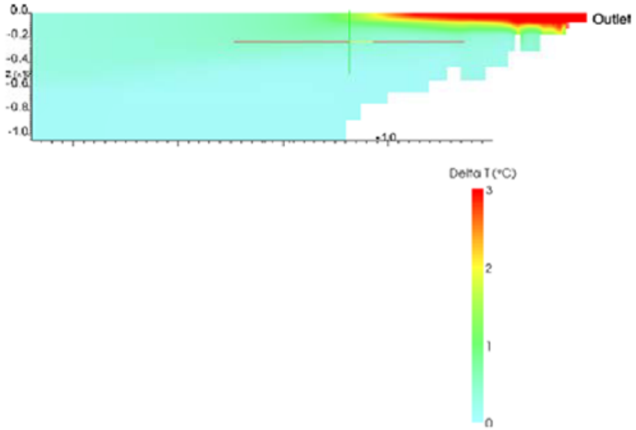


Figure 2 - Buoyant spreading processes downstream at the outlet. The thermal plume remains confined to a depth not larger than 2.0 m

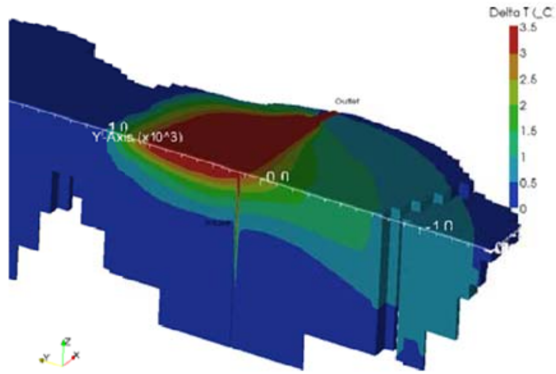


Figure 3 – Isothermal lines. ΔT in the vertical section at the intake point

Make Up Water and Waste Water Discharge

For the operation of 1 Unit, the overall average make-up water need will be about 646 t/h.

After the treatment in the Sea Water Reverse Osmosis Plant, there will be a discharge of brine directly to the sea of about 411 t/h on average.

Waste water will be collected in the sewage treatment plant. The average waste water treatment flow rate discharged to the sea will be about 66 t/h.

For the operation of 2 Units, the overall average consumption of make-up water will be about 1.140 t/h. Moreover, about 50 t/day of potable water are needed and it is assumed to take it from the industrial water system.

After the treatment in the Sea Water Reverse Osmosis Plant, there will be a discharge of brine directly to the sea of about 725 t/h on average.

The average waste water treatment flow rate discharged to the sea will be about 123 t/h.

The plant has been designed considering several systems to prevent water polluted discharges in the Adriatic Sea: Industrial Water Treatment Plant; Waste Water Storage Tanks; Biological Waste Water Treatment Plant; Waste Water Treatment Plant.

Waste water will be discharged in to the sea according to liquid discharge limits (*Table 4.6.3a*), as established in the *decision No. 177, dated 31.03.2005 based on law No. 9115 dated 24. 07. 2003*. Before the final discharge, water will be collected in a basin, where an automatic monitoring system will verify the compliance to the above mentioned limits.

Water balance for phase 1 and phase 2 operation are reported in Annex 2 and 3.

6.4. NOISE

6.4.1. *Construction Phase*

Noise during construction phase comes mainly from the equipments used for soil movements and site preparation, from the heavy vehicles used for material handling and from the vehicles used by employees (this latter is concentrated at the beginning and the end of the working day).

As far as noise emissions are concerned, the construction period is divided into four different phases:

- preliminary site preparation;
- foundations works;
- buildings construction;
- completion, paving and clearing.

During the first phase the equipments used are only machineries for soil movements (excavators, scrapers, compaction machines, dozers, etc.) and dumpers.

In the subsequent phases there are also machineries used to move materials (cranes), stationary machineries (pumps, generators, compressors, etc.) and various machineries (saws, drills, pneumatic hammer, etc.).

The overall noise produced during construction phase comes from several typologies of equipments used and from specific activities; therefore, it is very variable during the day and among the different phases.

The most critical phase identified, relevant in terms of noise emissions, is the preliminary site preparation; therefore, such activity has been analyzed in the following *Paragraph* to evaluate the maximum foreseen impacts during construction phase.

Construction activities will occur only during day period, from early morning until afternoon, usually from 7.00 up to 17.00; it has been assumed that such activities will last ten months.

This *Paragraph* presents the following:

- acoustical legislation concerning construction activities;
- assessment of noise impact during construction phase of the *Power Plant*;
- conclusions.

6.4.1.1. *Acoustical Legislation*

With regard to noise legislation, Albania has not set limit values for noise in its territory; therefore some international guidelines have been taken into account, in addition to the national legislation (*Law n. 9774 of 12 December 2007* "on the environmental noise assessment and management").

In particular *Directive 2000/14/CE of the European Parliament and of the Council of 8 May 2000* on noise emissions in the environment due to equipments for outdoor uses, modified by *Directive 2005/88/CE of the European Parliament and of the Council of 14 December 2005*, sets emission limits, expressed as sound power from equipment.

The next *Table* shows the acceptable sound power level of the main equipments used during construction works.

Table 6.4.1.1a Equipments and Related Acceptable Sound Power Level (Directive 2000/14/CE)

Type of equipment	Net installed power P (kW) Electric power P_{el} [1] (kW) Mass of appliance m (kg) Cutting width L (cm)	Acceptable sound power level (dB(A)/1 pW) Stage I as from 3/01/2002	 Stage II as from 3/01/2006
Compaction machines (vibrating rollers, vibratory plates, vibratory rammers)	$P \leq 80$ $80 < P \leq 70$ $P > 70$	108 109 $89 + 11 \log_{10} P$	105 [2] 106 [2] $86 + 11 \log_{10} P$ [2]
Tracked dozers, tracked loaders, tracked excavator-loaders	$P \leq 55$ $P > 55$	106 $87 + 11 \log_{10} P$	103 [2] $84 + 11 \log_{10} P$ [2]
Wheeled dozers, wheeled loaders, wheeled excavator-loaders, dumpers, graders, loader-type landfill compactors, combustion-engine driven counterbalanced lift trucks, mobile cranes, compaction machines (non-vibrating rollers), paver-finischers, hydraulic power packs	$P \leq 55$ $P > 55$	104 $85 + 11 \log_{10} P$	101 [2][3] $82 + 11 \log_{10} P$ [2][3]
Excavators, builders'hoists for the transport of goods, construction winches, motor hoes	$P \leq 15$ $P > 15$	96 $83 + 11 \log_{10} P$	93 $80 + 11 \log_{10} P$
Hand-held concrete-breakers and picks	$m \leq 15$ $15 < m < 30$ $m \geq 30$	107 $94 + 11 \log_{10} m$ $96 + 11 \log_{10} m$	105 $92 + 11 \log_{10} m$ [2] $94 + 11 \log_{10} m$
Tower cranes		$98 + \log_{10} P$	$96 + \log_{10} P$
Welding and power generators	$P_{el} \leq 2$ $2 < P_{el} \leq 10$ $P_{el} > 10$	$97 + \log_{10} P_{el}$ $98 + \log_{10} P_{el}$ $97 + \log_{10} P_{el}$	$95 + \log_{10} P_{el}$ $96 + \log_{10} P_{el}$ $95 + \log_{10} P_{el}$
Compressors	$P \leq 15$ $P > 15$	99 $97 + 2 \log_{10} P$	97 $95 + 2 \log_{10} P$
Lawnmowers, lawn trimmers/lawn edge trimmers	$L \leq 50$ $50 < L \leq 70$ $70 < L \leq 120$ $L > 120$	96 100 100 105	94 [2] 98 98 [2] 103 [2]

(1) P_{el} for welding generators: conventional welding current multiplied by the conventional load voltage for the lowest value of the duty factor given by the manufacturer.
P_{el} for power generators: prime power according to ISO 8528-1:1993, point 13.3.2

(2) The figures for stage II are merely indicative for the following types of equipment:

- walk-behind vibrating rollers;
- vibratory plates (> 3kW);
- vibratory rammers;
- dozers (steel tracked);
- loaders (steel tracked > 55kW));
- combustion-engine driven counterbalanced lift trucks;
- compacting screed paver-finishers;
- hand-held internal combustion-engine concrete-breakers and picks (15 < m < 30);
- lawnmowers, lawn trimmers/lawn-edge trimmers.

Definitive figures will depend on amendment of the Directive following the report required in Article 20, Paragraph 1. In the absence of any such amendment, the figures for stage I will continue to apply for stage II.

(3) For single-engine mobile cranes, the figure for stage I shall continue to apply until 3 January 2008. after the date, stage II figures shall apply.

The permissible sound power level shall be rounded up or down to the nearest integer number (less than 0,5, use lower number; grater than or equal to 0,5, use higher number)

As indicated by the *Directive 2000/14/CE of the European Parliament and of the Council of 8 May 2000*, all noise emitting equipments should be properly maintained to minimize the noise impact on the area and should comply with the applicable EU noise standards for such equipments.

6.4.1.2. *Assessment of Noise Impacts*

During the preliminary site preparation the most critical aspect is the presence, at the same time, of several vehicles (dumpers, excavators, dozer, etc.) in the area; during this phase, about 1.600.000 m^3 of soil will be brought into the site.

Table 6.4.1.2a shows, for each equipment used during this phase, the typical value of electric power installed and the foreseen value of sound power, calculated as indicated by the above cited *Directive*.

The electric power shown for each equipment is usually the maximum value, therefore the sound power levels calculated are potentially the highest.

Table 6.4.1.2a Type of Equipment Usually Used During Construction Phase

Type of equipment	Power P (kW)	Sound Power L_W limit from 3/01/2006 [dB(A)]*
Compaction machines	150	109
Tracked dozers	220	110
Wheeled excavators	120	105
Dumpers	120	105

* Directive 2000/14/CE of the European Parliament and of the Council of 8 May 2000

During the preliminary site preparation, it is foreseen to use the following equipments at the same time:

- 2 compaction machines;
- 2 tracked dozers;
- 15 wheeled excavators;
- 20 dumpers.

In order to calculate the sound power pressure level due to the equipments used during the construction phase, a semi-spherical omnidirectional free field propagation model, applying the following formula, has been used:

$$L_P = L_W - 20 \log r - 8 \qquad (6.4.1a)$$

where:

- L_P is the sound pressure level, at distance r, in dB;
- L_W is the source sound power level, in dB;
- r is the distance between source and reception point, in meters.

Considering the distance of the main receptors, it was also assumed that all the above loudest equipments are operating at the same time in the barycentre of the area.

The sound pressure levels at the different distances were calculated using the sound power levels reported in *Table 6.4.1.2a* and assuming a propagation in semi-spherical field (through *Formula 6.4.1a*).

Table 6.4.1.2b reports the highest sound levels which could occur in 1.000 m radius around the construction yard.

Table 6.4.1.2b Noise Pressure Levels During Construction Phase

Type of equipment	Number	Total noise pressure level [dB(A)] at			
		100 m	200 m	400 m	1000 m
Compaction machines	2	64	58	52	44
Tracked dozers	2	65	59	53	45
Wheeled excavators	15	69	63	57	49
Dumpers	20	70	64	58	50
Total	39	73.5	67.5	61.5	53.5

During the construction phase (in the phase considered as the most critical), the sound levels are about 73 dB(A) at a distance of 100 m from the yard and decrease to about 53 dB(A) at 1.000 m from the yard.

In the surrounding of the *Power Plant* the nearest building is a bathing establishment at 250 meter (marked as receptor P1 in *Figure 5.5.3a*, at *Paragraph 5.5.3*); here sound level from the equipment used during construction phase is about 65 dB(A).

The nearest dwelling houses, located to the north east side of the site (receptor P4 in *Figure 5.5.3a*) are at more than 1.000 meters, where the sound pressure level is about equal to 53 db(A).

As already stated, the construction activities do not have to comply with limits set by laws in force; however, the foreseen sound pressure levels near receptors (either residential and educational or commercial) are lower than the limit values fixed by World Health Organization (respectively 55 dB(A) and 70 dB(A), during day period).

6.4.1.3. *Conclusions*

Considering that the area of interest is a green-field land underpopulated and that the construction phase will be temporary, the noise impact during construction phase will be not relevant.

6.4.2. *Operational Phase*

This *Paragraph* describes the noise impacts due to the new *Power Plant* operation and includes:

- a description of the prediction mathematic model used in order to evaluate impacts;
- the results of the model;
- the conclusions.

6.4.2.1. *Mathematic Model*

The program used to calculate noise levels (SoundPLAN 6.5) applies the "ray tracing" method.

Sources are surfaces or points: each source propagates sound waves. The resulting acoustic field depends on the absorptions and reflections characteristics of all existent obstacles, in between the source and the receptor. Every ray carries a part of the acoustic energy of the sound source.

The energy decreases along the way, as a result of the absorption of surfaces, geometrical divergence and atmospheric absorption.

The absorption of sound energy by air is related to the dispersion of energy caused by the collisions of air molecules among them. Every collision scatters one small part of the energy and causes more impacts.

In the area of interest, the acoustic field will be the result of the sum of the acoustic energies of "n" rays which reach the receiver. The levels in the whole area are indicated with coloured stripes, with 5 dB steps, at the conventional height of 4 meters from ground.

The mathematical model uses international standards for sound attenuation in the environment (ISO 9613 - 2). This standard has many equations regulating the propagation and it allows calculating the result in the area, with a defined accuracy.

The aim of such methodology is to determine the equivalent continuous A-weighted sound pressure level, as described in ISO 1996/1-2-3, under meteorological conditions favourable to sound propagation from sources of known power emission.

As all the receivers are considered to be downwind from the source, the propagation triggers under the worst wind conditions, as specified in ISO 1996/2 (part 5,4,3,3).

A group of point sources can be described by one equivalent point source located within the group in the following cases:

- the source has got approximately the same intensity and height from the ground;
- the source has got the same conditions of propagation towards the reception point;
- the distance between the representative point and the receiver (d) is greater than the double of the maximum diameter of the source area (2D).

If the distance (d) is smaller or if the conditions of propagation for the various points of the source are various, the total source must be divided into single sources.

In this study this simplified technique has not been adopted.

6.4.2.2. *Method of Calculation*

The medium level of sound pressure to the receiver in downwind conditions is calculated for every source (specific IEC 255) with:

$$L_{downwind} = L_{WD} - A$$

$L_{downwind}$ is the effective level of sound power in the propagation direction. It is defined as:

$$L_{downwind} = 10 \log \frac{1}{t_2 - t_1} \int \frac{1}{t_2 - t_1} dt$$

The factor A is the attenuation that the sound energy endures during the propagation and it is composed of the following contributors:

$$A = A_{div} + A_{atm} + A_{ground} + A_{refl} + A_{screen} + A_{misc}$$

where:

- A_{div} = attenuation due to geometrical divergence;
- A_{atm} = attenuation due to atmospheric absorption;
- A_{ground} = attenuation due to the ground effect;
- A_{screen} = attenuation due to shield effects;
- A_{refl} = attenuation due to reflections from obstacles;
- A_{misc} = attenuation due to other effects.

The scale (A) can be applied singularly to every contributor or, in a second moment, to the sum calculated for every octave band, as in this study. The continuous equivalent sound level is the result of the sum of the single pressure levels, obtained for each source in each frequency, if requested.

The resulting sound power level in the direction of propagation L_{WD} depends upon the power level in free field conditions L_W and a term that specifies the directivity.

DC quantifies the variation of the radiation towards more directions of one directional source in comparison to the same non-directional one.

$$L_{WD} = L_W + DC$$

For a non-directional point source the contribution of DC is 0 dB. The correction of DC comes out from the index of directivity of the source, adding a K0 index that considers the emission in a defined solid angle.

For a source with spherical propagation in a free space K0 = 0 dB; when the source is near to a reflecting surface that is not the ground, K0 = 3 dB; when the source is in front of two perpendicular reflecting surfaces, one of which is the ground, K0 = 3 dB; if none of them is the ground, K0= 6 dB; with sources in front of three perpendicular surfaces, one of which is the ground, K0 = 6 dB; with sources in front of three reflecting surfaces and none of them is the ground, K0 = 9 dB.

The attenuation for geometric divergence can be evaluated theoretically as:

$$A_{div} = 20 \log (d/d0) + 11$$

where:

- d is the distance between the source and the receiver, calculated in meters;
- d0 is the reference distance, 1 m.

The absorption of the air is defined as:

$$A_{atm} = ad/1000$$

where:

- d is the distance of propagation, expressed in meters;
- a is the coefficient of atmospheric attenuation, in dB/km.

The coefficient of atmospheric attenuation depends mainly on sound frequency, environmental temperature, relative air humidity and atmospheric pressure.

The attenuation due to the ground effect comes from the interference between the sound reflected from the ground and the sound with direct propagation from the source to the receiver.

For this methodology of calculation, the surface of the land between the source and the receiver has to be flat, horizontal or with one constant slope. In alternative, a breaking line has to be drawn in the model.

There are three main regions of propagation: one of the source, one of the receiver and an intermediate one. Each of these zones can be described with a factor related to the characteristic detailed lists of reflection.

The methodology for the calculation of land attenuations can make use of one more simplified formula, which considers the distance d receiver-source and the medium height from the ground of the propagation way (hm):

$$A_{ground} = 4.8 -(2\ hm/d)(17 + (300/d))$$

The attenuation by reflection refers to surfaces like facades of buildings, which cause an increase of the sound pressure level to the receiver.

An important term is the attenuation due to the presence of obstacles (a little deep backs, barrier or screen).

The barrier must be considered a close and continuous surface without interruptions. Its perpendicular horizontal dimension to the line source-receiver must be greater than the wavelength l to the frequency of centre band for the considered octave band. According to the standards, the attenuation due to the shielding effect will be given by "insertion loss", that is from the difference between the levels of pressure measured to the receiver in a specific position with and without the barrier.

The effects of diffraction of the barrier edges are also considered (thick barriers). When one is in presence of more than two screens, the more effective ones are chosen and the other ones are rejected.

The term of mixed attenuation is the result of many effects:

- attenuation due to propagation through leaves;
- attenuation due to the presence of obstacles with big dimensions, for diffraction due to buildings or plants;
- attenuation due to the propagation through an obstacle, for shield effect or house reflection.

6.4.2.3. *Studied Objects*

The new *Power Plant* will be made of two units of 800 MWe each, to be built in two stages. So, in order to evaluate the sound levels due to both configurations, two scenarios were simulated:

- Scenario 1: one 800 MWe unit;
- Scenario 2: two 800 MWe units.

The study process consists in defining the sound powers of all noise sources able to influence the global noise levels.

Figure 6.4.2a shows the location, on the plant map, of the main noise sources. The values of the sound power levels assumed for machineries and systems are reported in the following *Table*.

Table 6.4.2.3a Sound Power Level of the Main Noise Sources

N.*	Main acoustical sources	L_w dB(A)	N.*	Main acoustical sources	L_w dB(A)
9	Ultrasupercritical (usc) boiler	115.7	29	Auxiliary boiler	105.5
10	Coal bunkers (coal mill)	110	32	Coal conveyors from the pier to t1	108
11	Fabric filter	108.5	32	Coal conveyors from t1 to t2	108
12	Induced fan	102.5	33	Coal towers (t1)	111
13	Gas-cooler	102	33	Coal towers (t2)	103.5
14	Flue gas desulphurization (FGD) unit	106	33	Coal towers (t3)	107
15	Auxiliary FGD building	101.5	34	Ashes and gypsum loading machine	91
	2 vent aeration fans over the auxiliary building	90 x 2	36	Urea to ammonia plant and building	98.5
16	FGD slurry recovery storage tank	94	37	Limestone storage area	105
17	Flue gas duct	101	38	Limestone crushing and milling house	103.5
18	Flue gas stack	107	42	Gypsum and ashes conveying system tower	106
19	Main machine hall building	108.5	44	Biological waste water treatment plant	97
	10 vent fans of aeration over the machine building	90 x 10	46	Industrial water treatment system	95
20	Main transformers	107.5	49	Demineralization plant	108.5
21	Auxiliary transformers	101	53	Waste water treatment plant	99
23	Cooling water intake ducts	negligible	64	A stacker	111
24	Cooling water pumps basin and building	105.5	64	B reclaimer machine	104
25	Cooling water discharge ducts	negligible	68	Coal floating transfert system	113
26	Fire fighting building (sea water pumps)	80	72	Coal conveyor t2-t3	108
28	Air compressors building	107.5	72	Coal conveyor t3-bunker	108

*) Identification number in Annex 1

6.4.2.4. *Results*

The modelling results are summarized in the following *Tables*, which present: the limit values, the existing noise levels measured in each point (residual noise, analysed in *Paragraph 5.5*), the *Power Plant* contribution and final noise levels during operation (noise expected).

The results are reported considering either Scenario 1 (800 MW) and Scenario 2 (1.600 MW), during day and night period.

Table 6.4.2.4a Foreseen Noise Contribution of the Power Plant Operation (Scenario 1)

Point	Day period			
	Limit value (dBA)	Residual noise (dBA) (*)	Plant contribution (dBA)	Noise expected (dBA)
P1	70	54.7	50.20	56.0
P2	55	51.6	49.86	53.8
P3	70	58.2	46.74	58.5
P4	55	49.5	40.95	50.1
P5	55	64.2	30.09	64.2
P6	55	55.1	40.58	55.3
P7	55	53.7	34.12	53.8

Note:
(*) Evaluated by noise survey on July 2008

Point	Night period			
	Limit value (dBA)	Residual noise (dBA) (*)	Plant contribution (dBA)	Noise expected (dBA)
P1	70	45.9	50.20	51.6
P2	45	45.2	49.86	51.1
P3	70	56.5	46.74	56.9
P4	45	41.8	40.95	44.4
P5	45	47.0	30.09	47.1
P6	45	-	40.58	-
P7	45	56.1	34.12	56.2

Note:
(*) Evaluated by noise survey on July 2008

Table 6.4.2.4b *Foreseen Noise Contribution of the Power Plant Operation (Scenario 2)*

Point	Limit value (dBA)	Day period Residual noise (dBA) (*)	Plant contribution (dBA)	Noise expected (dBA)
P1	70	54.7	50.0	56.0
P2	55	51.6	50.8	54.2
P3	70	58.2	48.1	58.6
P4	55	49.5	42.0	50.2
P5	55	64.2	31.1	64.2
P6	55	55.1	41.6	55.3
P7	55	53.7	35.0	53.8

Note:
(*) Evaluated by noise survey on July 2008

Point	Limit value (dBA)	Night period Residual noise (dBA) (*)	Plant contribution (dBA)	Noise expected (dBA)
P1	70	45.9	50.0	51.4
P2	45	45.2	50.8	51.8
P3	70	56.5	48.1	57.1
P4	45	41.8	42.0	44.9
P5	45	47.0	31.1	47.1
P6	45	-	41.6	-
P7	45	56.1	35.0	56.2

Note:
(*) Evaluated by noise survey on July 2008

Figures 6.4.2.4c and *6.4.2.4d* present, with coloured stripes, the noise values expected in the surrounding of the *Power Plant*.

For both scenarios the modelling results show that, excluding points already exceeding the limit values at present (P5, P6 and P7), in all other points the new *Power Plant* will not induce a significant increase in noise values. Only in point P2 during night period limits are overcame due to the Power Plant operation.

Tables 6.4.2d and *6.4.2e* show that, except for point P2, also differential limits are below the limit everywhere. Such limit values should not be applied in industrial and commercial areas.

Table 6.4.2.4c Foreseen Differential Value Related to the Power Plant Operation (Scenario 1)

Point	Day period Residual noise (dBA) (*)	Noise expected (dBA)	Differential Value (dBA)(**)
P1	54.7	56.0	-
P2	51.6	53.8	2.2
P3	58.2	58.5	-
P4	49.5	50.1	0.6
P5	64.2	64.2	0.0
P6	55.1	55.3	0.2
P7	53.7	53.8	0.1

Note:
(*) Evaluated by noise survey on July 2008
(**) Limit Value: 3 dB(A). fixed by World Health Organization in the document *"General EHS - Environmental, Health, and Safety - Guidelines"*

Point	Night period Residual noise (dBA) (*)	Noise expected (dBA)	Differential Value (dBA)(**)
P1	45.9	51.6	-
P2	45.2	51.1	5.9
P3	56.5	56.9	-
P4	41.8	44.4	2.6
P5	47.0	47.1	0.1
P6	-	-	-
P7	56.1	56.2	0.1

Note:
(*) Evaluated by noise survey on July 2008
(**) Limit Value: 3 dB(A). fixed by World Health Organization in the document *"General EHS - Environmental, Health, and Safety - Guidelines"*

Table 6.4.2.4d Foreseen Differential Value Related to the Power Plant Operation (Scenario 2)

Point	Day period Residual noise (dBA) (*)	Noise expected (dBA)	Differential Value (dBA)(**)
P1	54.7	56.0	-
P2	51.6	54.2	2.6
P3	58.2	58.6	-
P4	49.5	50.2	0.7
P5	64.2	64.2	0.0
P6	55.1	55.3	0.2
P7	53.7	53.8	0.1

Note:
(*) Evaluated by noise survey on July 2008
(**) Limit Value: 3 dB(A). fixed by World Health Organization in the document *"General EHS - Environmental, Health, and Safety - Guidelines"*

Point	Night period Residual noise (dBA)(*)	Noise expected (dBA)	Differential Value (dBA)**
P1	45.9	51.4	-
P2	45.2	51.8	6.6
P3	56.5	57.1	-
P4	41.8	44.9	3.1
P5	47.0	47.1	0.1
P6	-	-	-
P7	56.1	56.2	0.1

Note:
(*) Evaluated by noise survey on July 2008
(**) Limit Value: 3 dB(A). fixed by World Health Organization in the document *"General EHS - Environmental, Health, and Safety - Guidelines"*

6.4.2.5. *Conclusions*

As shown in previous figures, the plant will always respect at the fence the limit value of 70 dB(A) fixed by World Health Organization in the document *"General EHS - Environmental, Health, and Safety - Guidelines"* for industrial sites.

Inside the industrial or commercial areas, the values are always below limits in each point, either in Scenario 1 or in Scenario 2.

Inside the residential area, in both scenarios, during day period the *Power Plant* operation doesn't induce an overcoming in limits, being residual noise at present in points P5 and P6 already exceeding the limit values.

During night period, point P2 shows noise values, due to the *Power Plant*, higher than limits in force.

Also differential limits are below the limits in all points, except P2.

6.5. VEGETATION, FLORA, FAUNA AND ECOSYSTEMS

The main impacts on ecosystems, due to the implementation of the power plant project, refer both to the construction phase and to the operational phase. The impacts due to air emissions and water discharges during operation are assessed taking into account two different scenarios.

This document does not include the impacts on ecosystems caused by the construction of the power lines.

6.5.1. *Construction Phase*

The impacts which could be expected during this phase are:

- habitat removal;
- soil and water pollution;
- noise emissions;
- dust emissions;
- increase of impacts between trucks and animals;
- introduction of invasive species.

6.5.1.1. *Habitat Removal*

The habitat removal during the construction phase is related to the land occupation for the building yard and the power plant site.

The area directly occupied during construction (about 80 ha, *Figure 4.5.1a*) is not a valuable natural habitat. Actually the fenced-in area is mainly characterised by the presence of a grass, tilled land and bushes vegetation, secondarily by salt marsh land and hydro - hygrophilic vegetation.

Figure 6.5.1.1a   Site Area (South)

Figure 6.5.1.1b   Site Area (North)

The salt marsh area and hydro - hygrophilic vegetation are the most interesting natural habitats within the site area because they can support large populations of migrating and wintering birds and animals such as *Emys orbicularis*.

Therefore, due to the limited extension of the area and its general low natural value, it can be considered that the occupation of natural habitats will not have a significant impact on the complex natural ecosystem of the area.

6.5.1.2. *Soil and Water Pollution*

Soil and water pollution may occur accidentally during construction phase. In order to avoid dispersion of pollutants, such as oil, specific attention will be paid in avoiding accidents and containment systems will be used.

6.5.1.3. *Noise Emissions*

Noise emissions are due to the traffic and the activities necessary to build the power plant.

The noise spreads far into the environment. Birds seem to be especially sensitive to traffic noise, as it directly interferes with their vocal communication and thereby affects their territorial behaviour and mating success (*Reijnen and Foppen, 1994*). Several studies have documented reduced densities of birds breeding near noise sources (traffic roads) (e.g. *Veen, 1973; Räty, 1979; Van der Zande et al., 1980; Ellenberg et al., 1981; Illner, 1992; Reijnen and Foppen, 1994*). Reijnen et al. (1995) observed that bird densities in open grasslands declined where the traffic noise burden exceeded 50 db(A). Birds in woodland reacted already at noise levels of 40 db(A). However, environmental factors such as the structure of vegetation, the type of adjacent habitat, and the relief of the landscape, will influence both noise spread and bird densities, and thus alter the amplitude of the noise impact (e.g. *Reijnen et al., 1997; Kuitunen et al., 1998; Meunier et al., 1999*). Moreover if the habitats near the noise source provide essential breeding habitats that are rare or missing in the surrounding landscape, bird densities near the noise source may not necessarily be reduced (*Laursen, 1981; Warner, 1992; Meunier et al., 1999*).

Given the construction phase is temporary and birds species mainly pass winter in the salt marsh land, the impact can be considered negligible.

Dust Emissions

The area and the concentration of dust due to the construction phase are assessed in paragraph 6.1.1. Dust emissions, as previously studied, will be significant in the site surrounding area up to a distance of about 500 meters from the fence. As a consequence, in this limited area a reduction of the Gross Productivity can be expected, for a period of approximately one year. No permanent impacts are foreseen.

6.5.1.4. *Increase of Impacts Between Trucks and Animals*

The increase of traffic, due to the construction phase, will cause an increase of fauna casualties.

The number of collisions generally increases with traffic intensity, animal activity and density. Temporal variations in road kills indicate different biological periods that influence the species' activity, such as the daily rhythm of foraging and resting, seasons for mating and breeding, dispersal of the young-of-the-year, or seasonal migration between winter and summer habitats (e.g. Van Gelder, 1973; Bergmann, 1974; Göransson et al., 1978; Aaris-Sorensen, 1995; GrootBruinderink and Hazebroek, 1996). The kill rate is probably not density dependent, but may vary linearly with population size. This implies that roads would kill a constant proportion of a population and therefore can have a significant impact on rare species. For many common wildlife species, such as rodents, rabbits, foxes, sparrows, or blackbirds, traffic mortality is generally considered as insignificant, accounting only for a small portion (less than 5%) of the total mortality (e.g. Haugen, 1944; Bergmann, 1974; Schmidley and Wilkins, 1977; Bennett, 1991; Rodts, 1998). Amphibians and Reptiles are the communities more affected by the presence of the street because they could be tread on by trucks and cars passing in the street.

The impact could be important depending on the traffic; nevertheless, given the road which will be used by the trucks, which will not cross the natural habitat, this impact can be considered negligible.

6.5.1.5. *Introduction of Invasive Species*

The loss of natural habitats can facilitate the colonization of invasive species which subtract habitat to the native species. The seeds of the invasive species can be brought from the other Albanian province by cars or trucks used during construction works.

Invasive species such as *Arundo donax, Alilanthus altissima* or *Robinia pseudoacacia* were observed during the field survey. If not controlled, these latter species could act as invaders colonizing degraded deforested areas.

Given the period of the construction phase (approximately 3+49 months for the first unit) this impact could not be considered negligible. Nevertheless, during and later the construction phase appropriate actions will carry out to prevent the colonization of the invasive species. The actions will be specific, depending to the foreseen invasive species.

6.5.2. *Operational Phase*

The operation of the power plant could induce the following impacts on ecosystems:

- air pollution;
- water discharges;
- noise emissions;
- increase of impacts between trucks and animals.

6.5.2.1. *Air Pollution*

The maximum yearly concentration of NO_x and SO_2 acceptable in the European countries for an area with valuable and sensitive flora are respectively 30 μg/m^3 and 20 μg/m^3 (WHO 2000, D.M. n.60/02). Thresholds limits of 60 μg/m^3 for NO_x and 35 μg/m^3 are prescribed by Albanian Decree n. 803/2003.

The emissions from the power plant induce concentrations that are everywhere and in both scenarios lower than the threshold limit. In particular, in the first scenario the maximum yearly concentrations are 0,76 μg/m^3 for SO_2 and 0,53 μg/m^3 for NO_x, in the second scenario the maximum yearly concentrations are 1,51 μg/m^3 for SO_2 and 1,06 μg/m^3 for NO_x (see *paragraph 6.1.2.5*).

The maximum yearly concentration of NO_x and SO_2 within the Rrushkull Protected Area (Outside the Study Area) will be lower than 0,21 μg/m^3 for SO_2 and 0,15 μg/m^3 for NO_x in the first scenario and 0,45 μg/m^3 for SO_2 and 0,32 μg/m^3 for NO_x in the second scenario.

6.5.2.2. *Water Discharges*

The potential main impacts due to water discharges are related to the effects of thermal water discharges.

The *Posidonia* meadows represent an important ecosystem in the Adriatic Sea and the climax habitat along the Mediterranean shorelines (infra-littoral plane). The main role played by marine phanerogam meadows and in particular by *Posidonia* are:

- stabilisation of the sea-bed through the development of an effective radical and stoloniferous apparatus;
- reduction of the intensity of movements of water softening effect of the "matte" and the layer of vegetation; high production of oxygen and organic material by means of photosynthesis;
- direct and indirect source for several organisms and starting point for a complete food web;
- habitat of choice for several commercially important species, such as fish, cephalopods and crustaceans;
- high production of oxygen and organic material by means of photosynthesis.

Thermal Water Discharge

All sub-tidal marine invertebrates and most fishes are poikiloterms organisms and their body temperature conforms to the ambient environment temperature. The decrease of seawater temperature value can generally cause:

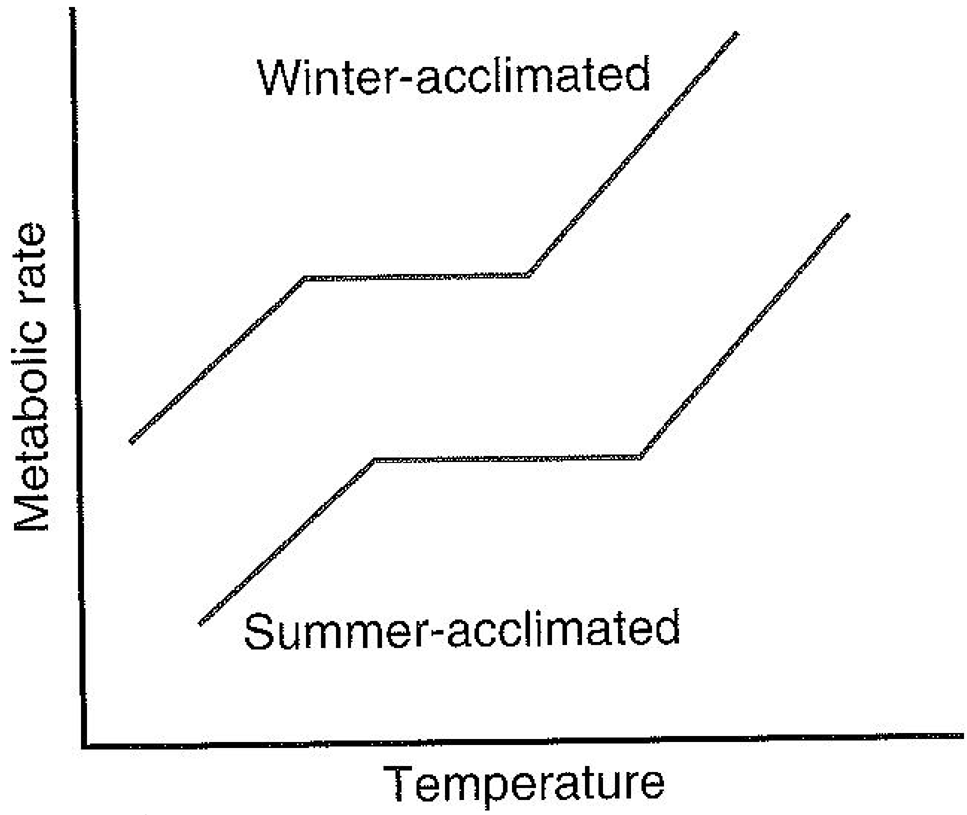
- thermal shock;
- change in metabolic rate;
- change in physiological performance.

There is usually a hierarchy of possible responses, depending on the importance of the environmental change. The effects on marine organisms change depending on the stage of their life (eggs, larvae, Juvanile, adults, etc.) and on the organism characteristics (stenothermal or eurithermal).

The most sensitive life stage of marine organisms is during reproduction, when they need optimal temperature range. For example, anchovy spawn in the Adriatic generally from April to October, in the optimum temperature ranges of 11,6 – 27,6 °C (*Slobodan Regner, 1996*) but it can live in a temperature range between 5-6 °C and 28 °C (survival temperature range).

In poikilotherms, the temperature variation causes the increase or decrease of the metabolic rate. If the temperature suddenly decreases, the metabolic rate will be very low and the animal will not be able to generate the energy needed for the activity; on the other side, if the temperature suddenly increases, the metabolic rate grows. To avoid possible negative effects, poikilotherms, living in seasonal environments, are able to acclimate to seasonal changes in temperature, shifting their metabolism-temperature relationship to new conditions (*Figure 6.5.2.2a*).

Figure 6.5.2.2a *Expected Response Curve of Metabolic Rate Versus the Temperature for an Animal Acclimated to Winter Low Temperature and the Same Animal Acclimated to Summer High Temperature*



Source: J.S. Levinton, 2001

The geographic distribution of marine species indicates that the natural selection has shifted the optimum response of species to the one of their native temperature regimen, even if the marine biota consists in assembling species whose optimum temperature ranges are different. The organisms which live in the study area are mainly eurithermal (they can live in a wide temperature range).

Based on the assumptions described in the previous paragraph, the mean lowest and highest registered temperature values in the study area are assumed as the threshold under and over which a potential adverse impact on biota is expected.

The monthly average seawater temperature ranges from about 12°C (in winter) to 24°C (in summer).

In order to assess the temperature variation produced by thermal discharge (in both scenario), the CFD computer code dispersion model was used. The complete modelling study is annexed to the present report.

More critical is the rapidity of temperature variation. Potential effects on biota due to the water discharge may be therefore expected only during the start-up phase, when the temperature is expected to suddenly increase at short distances from the discharge point. In fact, after the start-up, the discharge temperature will depend on the environmental conditions (temperature) of the sea and therefore the organisms will be able to acclimate to temperature variations.

However, the impacted area is very limited, and the various species can freely move towards the habitat characterized by an optimum temperature range.

The *Posidonia oceanica,* which is the most interesting marine habitat within the study area, is observed within 1,000 meters from the discharge point. *P.oceanica* is the endemic phanerogama of the Mediterranean sea, which can grow up to 44 meters depth, dueto light penetration, and needs the following conditions to live:

- salinity over 33‰ and under 41‰;
- temperature range between 10 and 28 °C (9 °C and 29,2 °C);
- not high hydrodynamic.

The mathematical model shows, in all situations examined, that the thermal plume deepens far away from the outlets, but is confined to a depth no larger than 3.0 m and the isothermal line correspondent to +3.0°C is no further off than 1 km from the discharge point; therefore impacts on marine biota are restricted in this volume of water. The most significant biota is located on the sea bed far from the impacted area, so the impacts on marine ecosystems could be estimated low.

6.5.2.3. *Noise Emissions*

In order to assess the noise pressure level due to the Power Plant activities the *SoundPlan* model was used.

In the first scenario the 45-50 dB(A) sound pressure level, in the worst case, are expected at 800 meters from the Power Plant (*Figure 6.4.2b*), while in the second scenario the 45-50 dB(A) sound pressure level, in the worst case, are expected at 1,000 meters from the Power Plant (*Figure 6.4.2c*)

The nearest natural habitats are within 1,000 meters from the Power Plant and are exposed to a sound pressure level of 55 dB(A). The main important species, which can live in these habitats (salt marsh land, sandy shoreline, etc), are limicoluos and water birds. It was observed, in another industrial site (Porto Marghera Venice Italy, Venice Province 2005), that the background noise due to the industrial activities has not stopped the presence of these birds near or inside the industrial area.

In accordance with the assumption reported in *§6.5.1.3*, the noise emissions due to the Power Plant activities will not have significant impacts on fauna distribution.

6.5.2.4. *Increase of Impacts Between Trucks and Animals*

The increase of traffic is due mainly to the transport of limestone and ashes. Based on the assumption reported in *Paragraph 6.5.1.5* and given that the road which will be used by the trucks will not across the natural habitat, this impact can be considered negligible.

6.5.3. *Bibliography*

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6.6. LANDSCAPE

The impacts on the landscape is assessed both through the analysis of the project and through the analysis of the landscape value, assessed in the *Paragraph 5.7*, compared with the value of the landscape incident of the Power Plant. The methodology is reported in the following table.

Table 6.6a *Standard to Assess the Landscape Impact of the Project*

Impact Assessment	Evaluation Parameters
Morphology and typology impacts	Conservation or change of the morphological characteristics of the area Use the same building typologies and cohesion with the land use in the surrounding area. Conservation or change of the historical, cultural and natural relationship
Impacts on local style, colours and materials of buildings	Cohesion, contrast or indifference of the project in relation to the surrounding area
Visual Impact	Impacts on a panoramic views
Environmental incidence	Impacts on the landscape ecology
Symbolic impact	Landscape elements which have a symbolic value for the local community

6.6.1. *Project Description*

The proposed Porto Romano Project foresees the realization of two coal fired Power Plants, to be erected in two different phases:

- Phase 1: erection of the first unit and of some facilities already designed to serve for the final Plant configuration, avoiding future construction constrains;
- Phase 2: construction of second unit.

Taking into account the above mentioned Project phases the impacts assessment has been carried out defining two different *Scenarios* (Scenario 1, referred to Phase 1 Project, and Scenario 2, where cumulative impacts of Phase 1 and Phase 2 are considered).

The most intrusive structures foresee, by the *Scenario 1 – Phase 1* are:

- Construction of higher Power Plant structures:
  - Boiler house, 110 meters;
  - Flue Gases Desulphurization (FGD) Unit, 45 meters ;
  - Power building, around 40 meters;
  - Fabric filter, 35 meters;
  - Stack: it will be made by PRFV pipe, supported either by a steel structure or by a reinforced concrete structure; another alternative, currently under investigation, is a reinforced concrete stack with acid resistant lining. Stack will be 150 meters height and with a diameter of about 8 meters;
- Open-air coal piles: about 450 m x 60 m, 23 meters taller, aligned along coastal line.

Considering that the Power Plant stack will be "wet-type" it is envisaged that, during Power Plant operation, the flue gases plume will be visible.

During *Phase 2*, most of the above described structures, will be doubled. The cumulative impact, with *Phase 1* structures, will be very limited considering that *Phase 2* structures will be located very close to the *Phase 1* ones.

6.6.2. *Impact on Landscape*

The project will change the morphological characteristics of the area, however, there are not representative buildings in a surrounding area close the site area. Therefore the impacts on local style, colours and materials of is not a relevant element in the impact assessment.

Moreover the project not located within the restricted/protected areas.

In order to properly assess the Project interferences on panoramic views, some relevant view point have been selected. Present landscape and prospects of the envisaged landscape (*Phase 1* and *Phase 2*) are shown in *Annexes 4-5-6-7*.

The future structures will be located in an area characterized by low landscape sensitivity and by the presence of some industrial installations (such as Tank farms, drainage pumping station and an existing jetty). The visual impact will be quite significant; anyhow, considering the absence of scenic view points and few potential landscape users, the foreseen impact related to the project is to be considered low.

The realization of the project will change the land use capability however the site area is not a natural area since it is a result of remediation activities.

The potential impacts on symbolic elements are related to the archaeological findings (*Figure 5.7.3a*), which are located outside the site area.

6.6.3. *Conclusion*

As reported in previous paragraphs the impacts on the landscape is assessed by comparing the landscape value of the area with the value of the landscape impacts associated to the Power Plant (*Table 6.6.3a*).

Table 6.6.3a *Project Impact on the Landscape*

Landscape Sensitivity	Evaluation Parameters	Landscape Impact
Low	Morphology and typology impacts Medium Impacts on local style, colours and materials of buildings Low Visual Impact Medium Environmental incidence Medium Symbolic impact Low	Low

Taking into account the low quality of the present landscape, the project impact on the landscape of Porto Romano can be considered overall low, although morphologic ad visual impact parameters can be classified with a medium impact level.

6.7. TRAFFIC

6.7.1. *Road Network*

6.7.1.1. *Construction Phase*

During construction phase the local road network will be modified and improved in order to facilitate the access to the construction yard.

In particular the one lane per direction road starting from the Highway (Durrës – Tirana) to Rinia will be enlarged and re-paved, bringing further positive impacts to the local viability. Two other paved roads are foreseen to connect this secondary road to the site area as shown in *Figure 6.7.1.1a*.

During construction phase about 2.000.000 m^3 of material will be transported by trucks to the site. The transportation will be relevant but distributed in a long period.

Figure 6.71.1a Future Paved Road Foreseen during Construction Phase

6.7.1.2. *Operational Phase*

During the operational phase local roads will be characterized by:

- An increase in local working personnel traffic, but the road enlargement proposed in the project can be considered more than sufficient to sustain local vehicles traffic increasing;
- Traffic along the new road network will be influenced by an increasing in trucks number. Trucks are involved into materials and compound (limestone, ashes, gypsum, urea etc) transportation.

In order to evaluate trucks movements, the following assumptions were considered:

- plant will work at the same intensity for the entire year;
- trucks/containers can carry no more than 30 tons of materials. The same size is expected for containers.

In phase 1 the following trucks movements are foreseen:

- *Limestone:* about 1,460 trucks in a year will transport limestone towards the plant site;
- *Urea:* about 150 containers are required in a year.

In phase 2 the following trucks movements are foreseen:

- *Limestone:* about 2,920 trucks in a year will transport limestone towards the plant site;
- *Urea:* about 300 containers are required in a year.

6.7.2. *Naval Traffic*

6.7.2.1. *Construction Phase*

During construction phase no significant naval traffic is foreseen.

6.7.2.2. *Operational Phase*

As reported in the project description, the coal supply will be provided to the Thermal Power Plant of Porto Romano by means of oceanic ships.

Each oceanic ship will reach a "landing area" approximately 3-4 km offshore. In that point, the coal will be loaded on barges and transported towards the pier where a conveyor belt will transfer it to the storage areas inside the plant.

Other materials, such as Gypsum and Ashes, will be evacuated from the Power Plant by ships.

The following naval movements are foreseen for the two operation phases of the *Power Plant*:

- Phase 1:
    - *Coal*: 13 (if we consider Cape Size of 150.000 DWT) – 24 (if we consider Panamax of 80.000 DWT) oceanic ships can reach the "landing area" in a year; about 85 days in a year will be characterized by the presence of the oceanic vessels off-shore the Power Plant area; the barges will work when oceanic vessels are present;
    - *Gypsum:* about 7 – 9 tank ships are required in a year to send gypsum from the plant, for a total amount of about 70,000 tons/year;
    - *Ashes:* about 44 barges are expected to be used in a year, loading 440,000 tons/year (the size of the ash ships could be variable in dependence of its final destination).
- Phase 2
    - *Coal:* about 26 (if we consider Cape Size of 150.000 DWT) – 48 (if we consider Panamax of 80.000 DWT) oceanic ships can reach the "landing area" in a year; about 170 days in a year will be characterized by the presence of the oceanic vessels off-shore the Power Plant area; the barges will work when oceanic vessels are present;
    - *Gypsum:* about 14 – 18 tank ships are required in a year to send gypsum from the plant, for a total amount of about 140,000 tons/year;
    - *Ashes:* about 88 barges are expected to be used in a year, loading 880,000 tons/year (the size of the ash ships could be variable in dependence of its final destination).

6.8. NON IONISING ELECTROMAGNETIC FIELDS

The only external electromagnetic sources of the Power Plants are:

- a 400 kV power line, about 26 km long, which connects the power station to Tirana 2 National Grid Power Station;
- a 500 kV DC undersea cable, about 210 km long, which goes to Italy, not included in the present Study.

The analysis of the Power Line to Tirana 2 Station and of the undersea cable to Italy is not included in the present Study.

6.9. SOCIOECONOMIC FRAMEWORK

From the socio-economic point of view, the main effects of the project are employment opportunities and energy availability and therefore can be considered positive on the whole. A specific Social Impact Assessment is planned to be performed to assess in detail the positive and negative influence of the *Power Plant* on the local economy and communities.

The effects on employment during construction and operation phases are summarized in the following *Paragraphs*.

6.9.1. *Construction Phase*

The construction of the Thermal Power Plant will provide job opportunities for a significant number of people.

In addition, Albanian part contracting will involve Albanian firms thus constituting a source of revenue. The presence of international contractors will also provide an indirect increase of revenue for local activities.

The construction phase will last approximately 49 months for each Power Plant unit, preceded by 3 months of preliminary works.

During this period approximately 1.650 workers will be employed on average with peaks of up to 2.500 workers during intense construction activity periods and in case both units are constructed with a time shift of 6 months between the start-up of the two units.

6.9.2. *Operational Phase*

During operation the *Power Plant* will employ approximately 140 people for the first unit. This number will increase up to 220 workers when the second unit is in operation.

Additional workforce will be employed by contactors that will be constantly operating on site to perform services such as canteen, cleaning, greenery, security.

6.10. PUBLIC HEALTH

6.10.1. *Construction Phase*

During the construction phase, the potential impacts on "Public Health", as explained in the next *Paragraphs*, can be linked to:

- dust mainly caused by materials movements;
- noise generated by vehicles and machineries.

Aspects related to atmospheric emissions and noise effects during the construction phase of the *Power Plant* are discussed respectively in *Paragraphs 6.1.1* and *6.4.1.*

6.10.1.1. *Atmospheric Pollution*

During the construction phase, at distances beyond 550 meters from the yard, the dust index is, i.e. the dust potentially settled is lower than 100 mg/m^{2}day.

Given the above mentioned results, dust depositions at the settlements of Rina, the closest inhabited area 1,000 m from the yard, are considered *Practically Absent*.

No impact is foresaw on public health.

6.10.1.2. *Noise*

Considering that the area of interest is a green-field land underpopulated and that the construction phase will be temporary, the noise impact can be considered not relevant.

6.10.2. *Operational Phase*

During operation, the potential impacts on "Public Health" can be linked to:

- diseases resulting from atmospheric emissions;
- effects of noise.

Aspects related to atmospheric emissions and to noise effects due to the *Power Plant* are discussed respectively in *Paragraphs 6.1.2.*and *6.4.2.*

6.10.2.1. *Atmospheric Pollution*

Effects on Public Health of air polluting emissions from industrial activities can be:

- non oncogenic, which could be toxic, harmful or irritating;
- oncogenic (teratogenic and mutagenic), which do not necessarily present immediate effects but can induce cellular alteration with time.

Non oncogenic pollutants include most of the inorganic compounds present in smoke (such as sulphur oxides and nitrogen oxides), heavy metals and toxic non metals (present in particulate). Oncogenic pollutants, instead, include polycyclic aromatic hydrocarbons and nickel.

Air emissions due to the *Power Plant*, in both scenarios considered in this Environmental Impact Study (see *§4.6.1*), are due to combustion products, mainly SO_2, NO_x and SPM (Suspended Particulate Matter).

Nitrogen Oxides

Levels of natural background concentrations in atmosphere are between 0.4 and 9.4 $\mu g/m^3$, differing widely from place to place. Levels of background (natural + anthropic) in European areas with low density of population are between 2,0 and 4,2 $\mu g/m^3$ and between 0.0 and 7.4 $\mu g/m^3$, respectively for nitrogen dioxide and oxides.

Effects of nitrogen dioxide on man and animals are various but never carcinogenic. The World Health Organization (WHO) considers as tolerable concentrations of 150 $\mu g/m^3$ protracted for 24 hours, and concentrations up to 400 $\mu g/m^3$ protracted for only one hour. The recommended annual average value is 40 $\mu g/m^3$. This limit is adopted as precautionary to protect sensitive subjects such as asthmatics and is set also by *Directive 1999/30/CE*. The limit set for maximum ground concentrations of NO_2 by Albanian legislation (*DCM n. 803 of the 2003)* is 60 $\mu g/m^3$.

The annual average ground concentration of NO_2 due to the operation of the *Power Plant* will be about 0.53 $\mu g/m^3$ in Scenario 1 and 1.06 $\mu g/m^3$ in Scenario 2 (*§ 6.1.2*), therefore negligible if compared to the above mentioned values.

Sulphur Oxides

Also this compound is included in the group of non oncogenic pollutants. Effects of sulphur oxides reveal themselves on man through irritations of skin, eyes and respiratory system mucosa, whereas, at higher concentrations respiratory pathologies as asthma and bronchitis could occur.

Due to its high solubility in water, SO_2 is easily absorbed by mucosa, therefore only very small amounts reach the deeper part of lungs.

Worrying events of exposure to SO_2 are uncommon since it is irritating already at very low concentrations. In spite of high concentrations of SO_2 necessary to induce harmful effects on healthy adult population, many health authorities consider SO_2 dangerous for elderly people and people affected by chronic diseases of the respiratory and cardiovascular system.

Currently, limits for air quality, set by *Directive 1999/30/CE*, establish that the annual average ground concentration of SO_2 doesn't have to exceed 20 $\mu g/m^3$. Albanian legislation (*Law AL DCM n. 803*) sets this limit in 35 $\mu g/m^3$.

The modelling activities carried out for this study show that the annual average ground concentration of SO_2 due to the operation of the *Power Plant* will be about 0.76 $\mu g/m^3$ in Scenario 1 and 1.51 $\mu g/m^3$ in Scenario 2 (*§ 6.1.2*), therefore negligible if compared to the values dangerous for public health.

Suspended Particulate Matter

Suspended Particulate Matter are particles, solid and liquid, with diameter between 0.1 and 100 μm, scattered in the atmosphere.

Particles with diameter greater than 10 µm can be considered less dangerous, since they settle quickly at ground and, if inhaled, they are retained by the early respiratory tract.

Decreasing their dimensions, particles become more dangerous because they penetrate more deeply in human organism.

Particles having a diameter smaller than 10 µm (PM10) penetrate in the upper respiratory tract (from nose to larynx); particles having diameter smaller than 2.5 µm (PM2.5) are 60% of the total PM10 and penetrate in the lower respiratory tract (from trachea nose to pulmonary alveoli).

Dusts are a complex physical-chemical mixture, made up either by primary component, sent out directly from the source, or by secondary component, formed later. Their composition, therefore, is very variable (heavy metals, sulphates, nitrates, ammonium, organic carbon, polycyclic aromatic hydrocarbons, dioxins/furans).

Directive 1999/30/CE establishes that the annual average concentration of PM10 doesn't have to exceed 40 µg/m^3 until 2010 and later on 20 µg/m^3. Albanian legislation (*Law AL DCM n. 803*) sets this limit in 60 µg/m^3.

The annual average concentration of PM10 due to the operation of *Power Plant* will be about 0,75 µg/m^3 in Scenario 1 and 1.16 µg/m^3 in Scenario 2 (*§ 6.1.2*), therefore negligible if compared to the values dangerous for public health.

In conclusion, ground concentrations induced by Porto Romano *Power Plant*, mainly SO_2, NO_x and SPM, are always under the limits set by laws in force for the protection of human health.

6.10.2.2. *Noise*

The results of the modelling activities carried out show that the noise values at the receptors in the surrounding area will not increase significantly due to the new *Power Plant,* neither in Scenario 1, nor in Scenario 2.

7

7. EIA MATRIX

In this Chapter is provided an EIA Matrix that summarized the main issues arisen from impact assessment of the project of the Porto Romano Thermal Power Plant.

The EIA Matrix is reported in two tables, one referred to construction Phase and another to operational phase, and it analyzes:

- the environmental sector affected;
- the environmental pressure determined by the project;
- the quantification, if possible, or the qualification of the impact;
- the type of impact (local/regional, transitory/permanent, reversible/irreversible);
- the description of the impact and/or the mitigation measures adopted by the project to reduce or to minimize the magnitude of the impact.

Table 7.1a *EIA Matrix - Construction Phase*

Sector	Environmental Pressures	Impacts	Type	Description / Mitigation Measures
Air Quality	Material handling and transportation	Increase of Dust concentration (significant only within the fence of the construction yard and in the areas closest to it)	Local Transitory, Reversible	Pile surface will be wetted to minimise the total particulate emissions from the materials storages. Trucks will be covered for material transportation
Soil	Soil consumption	the thermal power plant area (about 46 ha wide)	Local Permanent Reversible	Restorations for former owners are foreseen
		the construction area (about 18 ha wide)	Local Transitory Reversible	Site rehabilitation at works end
	Top soil removal and deep excavation	Top Soil removal (for about 0.50 m depth on the entire site)	Local Permanent Irreversible	This material will be used to fill the site, to build up wind breakers to protect the coal storage area and to recover landscape
Groundwater	Foundations Construction	Water table lowering will be temporarily required during deep foundation	Local Transitory Reversible	It is affected a low productive sandy aquifer (not representing a water supply source for the local population) having mainly poor quality water
Surface Water	Use of hazardous substances	Release of sludge, used oil, hydraulic fluid, paint, solvents and other similar materials	Local Transitory Reversible	All necessary security procedures will be applied, potential impact on sea water quality derived by occasional spills or releases will be minimized
	Modification on drainage system	Floods frequencies (above all in winter) due to the modification to the drainage system network	Local Transitory Reversible	the canal network will be re-designed around the site area
Noise	Machinery noise emissions during the construction phase	Modification of actual sound climate with new sound sources (they will be not continuous and will depend on the number and type of machinery used for each activity phase)	Local Transitory Reversible	Only areas close to site will be affected Utilisation of low sound emission machinery if needed
Vegetation, Flora, Fauna and Ecosystems	Elimination of vegetation present in the site	The area directly occupied by the *Power Plant* is characterised by the presence of salt and ruderal vegetation (without naturalistic value).	Local Permanent Irreversible	No natural or sensitive habitats are involved by site plant
Traffic	Road Network modification and improvement	Enlargement and re-pavement of road from the Highway (Dürres – Tirana) to Rinia	Local Permanent Irreversible	The project will improve the road connections for the villages close to the site
	Material transportation	Road transportation of about 1.600.000 m^3 of material by trucks	Local Transitory Reversible	No inhabited areas will be involved by trucks route
Socio Economic	New job opportunities (average 1.000 workers; peaks up to 2.500 workers	More revenues for local people and activities	Regional Transitory Reversible	Increase of competence in economic sector

Sector	Environmental Pressures	Impacts	Type	Description / Mitigation Measures
Public Health	Secondary effects	Dust caused by material movements Noise generated by vehicles and machineries	Local Transitory Reversible	Very low influence on Public Health: affected areas are limited to the areas close to the Plant, poorly inhabited

Table 7.1b *EIA Matrix - Operational Phase*

<table>
<tr><th>Sector</th><th>Environmental Pressures</th><th>Impacts</th><th>Type</th><th>Description / Mitigation Measures</th></tr>
<tr><td>Air Quality</td><td>Emission of pollutants substances (nitrogen dioxide - NO_2, sulphur dioxide - SO_2, particulate matters - SPM)</td><td>All concentrations of pollutants at soil level are in compliance to regulation (Directive 1999/30/EC and Albanian Law AL DCM no 803/2003). Following table shows maximum annual average calculated (µg/m³).
<table>
<tr><th></th><th>1 Unit</th><th>2 Units</th><th>Albanian limits</th><th>EC Limits</th></tr>
<tr><td>SO_2</td><td>0.76</td><td>1.51</td><td>35</td><td>20</td></tr>
<tr><td>NO_2</td><td>0.53</td><td>1.06</td><td>60</td><td>40</td></tr>
<tr><td>SPM</td><td>0.75</td><td>1.16</td><td>60</td><td>40</td></tr>
</table>
The expected values are very low compared to the regulation thresholds and will be compatible with the actual state of air quality.</td><td>Regional
Permanent
Reversible</td><td>The very low concentration calculated are reachable in force of the fuel gas treatment system adopted by the plant, that includes:
• SCR - Selected Catalytic Reduction - denitrification system;
• fabric filter for particulate matters removal, and
• wet desulphurization plant.
An automatic monitoring system installed in the stack will verify the compliance to the above mentioned limits
Moreover the plant is ready for a future installation of a Post Combustion Carbon Capture and Segregation System</td></tr>
<tr><td>Soil and Groundwater</td><td>Presence of potential soil and groundwater pollutants in the plant</td><td>In the plant are stored substances (chemical tanks, light oil and heavy fuel oil tanks, ashes silos area, limestone storage area, gypsum storage area, waste water storage areas, lubricant oil storages) those could determine soil and groundwater contamination.</td><td>Local
Permanent
Reversible</td><td>All storage areas will be paved and equipped, if needed, with containment basins of adequate capacity, avoiding potential soil and groundwater contamination</td></tr>
<tr><td>Surface Water</td><td>Water Thermal Discharge</td><td>The cooling water of the Power Plant is discharged into the sea. In all the analyzed scenarios, the plume extension will be limited and in compliance with applicable limits reported in Albanian law (decision No. 177, dated 31.03.2005 based on law No. 9115 dated 24. 07. 2003)</td><td>Local
Permanent
Reversible</td><td>The adopted design for heat cooling system assures the respect of the most strictly limits on thermal discharge.</td></tr>
<tr><td></td><td>Waste Water Discharge</td><td>Waste water discharge is in compliance with the applicable limits reported in Albanian law (decision No. 177, dated 31.03.2005 based on law No. 9115 dated 24. 07. 2003)</td><td>Local
Permanent
Reversible</td><td>The plant has been designed considering several systems to prevent polluted water discharges in the Adriatic Sea:
• Storm water "first flush" collection basins;;
• Local oil separators;
• Effluent treatment plant:
• Sewage Treatment Plant.
An automatic monitoring system will verify the compliance to regulatory limits of discharged waste water</td></tr>
<tr><td>Noise</td><td>Noise emission from the Plant</td><td>The operation of the Power Plant will have minor effects in the affected area. In particular, the modelling results show that, excluding the points already exceeding the limit values at present, in all other points the new Power Plant will not induce a significant increase in noise values. Only in a point during night period the limit is overcome due to plant operation.</td><td>Local
Permanent
Reversible</td><td>Periodical noise monitoring surveys will be carried out to control and minimize the noise impact</td></tr>
</table>

Sector	Environmental Pressures	Impacts	Type	Description / Mitigation Measures
Vegetation, Flora, Fauna and Ecosystems	Effect on sensitive habitats of air emission of pollutant	The concentrations in air of pollutants (shown above) exclude effects on vegetation. In the only protected area close to the site (Rrushkull) the maximum pollutants concentrations calculated are 0.45 ^{3}for NO_x and SO_2, in compliance to the limits set by EC Directive for vegetation protection (30 ^{3}for NO_x and 20 ^{3}for SO_2)	Regional Permanent Reversible	The technologies adopted to minimize impacts on air quality are reported above
	Water thermal discharge	The increase of water temperature could cause potential impacts on fauna and ecosystems. The area affected is very small (see above)	Local Permanent Reversible	A marine survey is carrying out to assess the possible interferences on natural habitats. If sensitive areas will be found during the survey, suitable mitigation actions will be carried out.
Landscape	Modification of visual characteristics of the site	The plant is composed by several high constructions (boiler houses – 110 m high, stacks – 150 m high). These structures will be long distance visible.	Regional Permanent Reversible	The plant will be located in an area characterized by low landscape sensitivity, with the presence of other industrial installations (such as Tank farms, drainage pumping station and a jetty).
Traffic	Increase of road traffic	The raw material supply to the plant will increase the number of trucks on the road network.	Local Permanent Reversible	The new roads for the plant assure that no inhabited areas will be affected by trucks route
Socio Economic	New job opportunities	During operation the *Power Plant* will employ approximately 140 people for the first unit and 220 workers when the second unit will be in operation. Additional workforce will be employed by contractors that will be constantly operating on site to perform services such as canteen, cleaning, greenery, security.	Regional Permanent Reversible	A specific Social Impact Assessment is planned to be performed to assess in detail the positive and negative influence of the *Power Plant* on the local population.
Public Health	Impacts on air quality	As shown above the concentrations of pollutants emitted by the Plant in inhabited areas are very low and will be compatible with the actual state of air quality. None impact on people health is foreseen.	Regional Permanent Reversible	As above
	Noise generated by plant operation	As shown above, only one inhabited house is affected by noise generated by the Plant. None impact on people health is foreseen.	Local Permanent Reversible	As above

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8. ENVIROMENTAL MANAGEMENT PLAN

The Environmental Management Plan (EMP) is aimed at verifying the compliance of the Project during construction phase and the environmental performances of the Power Plant operation.

The main monitoring activities foreseen by the EMP are described in the following. If non compliances will occur, the necessary corrective actions will be undertaken.

8.1. MITIGATION MEASURES AND COMPENSATION DURING CONSTRUCTION PHASE

8.1.1. *Guidelines for Conctractors's Action Plans*

The Contractor entrusted with the remediation activities and with the O&M activities of the power plant site shall produce an Environmental Management Plan that shall include mitigation and monitoring measures to be adopted to ensure that environmental impacts associated to Porto Romano Power Plant construction phase are controlled and minimized.

The minimum contents of the Contractor's Environmental Management Plan in terms of mitigation and monitoring measures are described in the following *Paragraphs*.

In addition, the Environmental Management Plan shall indicate the Contractors' procedures in terms of:

- Contractor's organization and responsible person for environmental issues;
- Site Induction and Environmental Awareness of the personnel working on site, including subcontractor's personnel. As a minimum induction courses shall include:
  - Information on the work equipment to be used;
  - Information on the substances to be used;
  - Information on any personal protective equipment to be used;
  - Environmental awareness (waste management, oil spills reaction, etc.);
  - Good site practice (housekeeping, noise control, energy saving, etc.).
- Environmental procedures (included in the EMP or in specific documents where appropriate) for the following issues:
  - Waste management;
  - Emissions to air;
  - Waste water;
  - Contamination of land;
  - Use of raw materials and natural resources;
  - Site reinstatement and aftercare;

- Emergency response;
- Monitoring, audit and inspection
- Environmental Records and reporting.

8.1.1.1. *Management of Waste, Effluents and Traffic*

With reference to waste management, a Plan shall be prepared by the contractor to ensure that management procedures for all kinds of waste are defined and communicated to the personnel operating on site.

Methods for waste disposal shall be established in liaison with the local authorities and appropriate waste disposal contractors.

The Waste Management Plan shall include all possible types of waste generated on site: tailing rock activities, waste oil, etc. and a strict anti-litter policy shall be established.

The contractor must ensure that each working site shall be provided with appropriate waste storage areas and containers, with proper labelling and indications.

A special attention will be paid by the contractor in management of trucks operation, in order to minimize dust emission.

In particular:

- Cover trucks shall be used for the transportation of soil;
- The service roads shall be paved with coarse material;
- Site personnel must be made aware that the unloading of trucks shall be performed slowly, in order to minimize dust formation;
- In case of very dry conditions the stockpiled material shall be softly sprinkled with water.

In addition, regarding the potential air pollution due to trucks and other equipment exhaust gases, trucks and engines used during operations shall be maintained to minimize exhaust fumes and prevent black smoke.

At the same time, compressors and generators must be kept off from areas close to residential houses.

8.1.1.2. *Traffic/Access Management Plan*

Before starting the construction works, the contractor shall verify that the conditions of roads and bridges are suitable for a safe transport of the construction materials to the site.

Moreover, the contractor shall:

- Impose speed limits;
- Use covered trucks;
- Impose vehicle safety maintenance and secure load requirements;
- Establish adequate parking areas;

- Forbid unattended unloading of vehicles.

8.1.1.3. *Pollutant Spill Contingency Plan*

The contractors shall verify that any loading/unloading operation is conducted safely.

In particular:

- Disposal to the ground or in the channels of oil, diesel fuel and any chemical is strictly forbidden.
- Refuelling areas must have a hard, impermeable surface that is drained to an oil interceptor. They must be located no less than 50 m from any water course or from the sea.
- Use impervious surfacing, drip-trays, etc. to prevent ground pollution under stationary vehicles.

Moreover, the following actions should be implemented in case of a spill to prevent or moderate environmental impact that can arise:

- Stop work in progress in safety conditions;
- Stop the spilling cause and, at the same time, guarantee one's own and other people's safety;
- Prevent liquids from flowing into road drains, rivers or in the sewer system through plastic bags and other material;
- Raise material by proper systems, put it in sacks or watertight containers and send it to the hazardous waste skip/container (the incidentally contaminated ground must be removed where the liquid is penetrated).

8.1.1.4. *Hazardous Material Management Programme*

Each chemical product will be supplied with its own MSDS (in English language, and local language, whenever possible). A copy of MSDS of all chemicals will be provided in the storage areas. Section 14 of MSDS (Transport information) provides the transport hazard class for those substances that present a physical hazard according to the UN Recommendations on the Transport of Dangerous Goods.

Hazardous materials will be properly labelled and marked according to relevant legislation.

The following criteria should be adopted for hazardous chemicals storage:

- Hazardous material storage areas should be identified, labelled and properly marked;
- Storage areas must be foreseen with spill containment system;
- Containment curbs should be present around the loading and unloading area;
- Storage area should be paved, fenced and marked;
- Storage area should be provided with an emergency spill kit;

- Incompatible materials should be separated in accordance with the segregation requirements between the various classes of dangerous goods;
- Inspections should be carried out periodically in order to verify potential leakage for spills.

8.1.1.5. *Health & Safety Management*

Health & Safety issues shall be carefully addressed by contractors.

In order to protect the site area from unauthorized access, a perimeter security fence will be erected and warning signs will be appointed all-around the work area.

The access will be granted only to authorized personnel, which shall exhibit a proper identification tag.

Before starting work, personnel will receive proper training on potential hazard and risk.

During work, personnel must wear proper PPE.

8.2. MITIGATION MEASURES AND COMPENSATION DURING OPERATION

8.2.1. *Environmental Mitigations and Compensations*

Air Quality

The very low concentrations, as calculated by the model, are achievable in force of the fuel gas treatment system adopted by the plant, that includes:

- SCR - Selected Catalytic Reduction - denitrification system;
- fabric filter for particulate matters removal, and
- wet desulphurization plant.

An automatic monitoring system installed at the stacks will verify the compliance with the applicable limits.

Data acquired by the system will be stored for analysis and reporting purpose, and will be available for evaluation by the competent authorities.

Specific procedures and operational instructions will be implemented within the EMP, in order to assign roles and responsibilities to ensure compliance for air emissions.

8.2.1.1. *Soil*

All storage areas will be paved and equipped, if needed, with containment basins of adequate capacity, avoiding potential soil and groundwater contamination.

8.2.1.2. *Water*

The adopted design for the heat cooling system grants the respect of the most strict limits on thermal discharge.

The plant has been designed considering several systems to prevent polluted water discharges in the Adriatic Sea:

- Storm water "first flush" collection basins;
- Local oil separators;
- Effluent treatment plant;
- Sewage treatment plant.

An automatic monitoring system will verify the compliance with the regulatory limits for discharged waste water.

8.2.1.3. *Noise*

During operation, any further needed mitigation measures will be adopted to reduce the noise impact generated by the plant.

Periodical noise monitoring surveys will be carried out to control and minimize the noise impact.

8.2.1.4. *Waste*

Waste management will be based on the waste minimisation approach, i.e. on the ALARP principle, with the objective to reduce the volume and toxicity of waste generated to the extent that is economically practical.

This will be made implementing waste minimisation strategies.

8.2.2. *Emergency Response and Preparedness Plan*

Emergency in this context means fire and medical case (or major property damage situation).

The Contractor shall survey the work area and record the following details:

- the number and location of exits;
- the paths of travel to each exit;
- the location and type of fire-fighting equipment (extinguishers, fire alarm panel, manual call points), first-aid;
- an acceptable location outside the work area for an assembly point.

On gathering the above information the Contractor shall draw, in a proper scale, the site area, with the indication of the room numbers, fire alarm panel, call points, fire-fighting equipment, exits, paths of travel to those exits (including stairs, if present) and the assembly point.

Specific procedures for emergency response shall be written and all personnel involved shall be aware of them.

8.3. ENVIRONMENTAL MONITORING AND REPORTING

8.3.1. *Construction Phase*

8.3.1.1. *Air Quality*

Considering the limited period of time of construction activities and their typical non–continuous pattern, there are no permanent emissions to be monitored. Contractor will monitor air emission from vehicles exhausts and other machineries. Monitoring will consist in visual check for black smoke in exhaust before and during activity. Special care for occupational health reason will be taken in dust monitoring and control. In case visible emissions should be present from exhausts, the relative equipment/machinery will be stopped and replaced, as far as practicable.

No reporting activities are foreseen.

8.3.1.2. *Soil*

Procedures and mitigation measures to avoid solid and liquid discharges onto the soil during construction phase are addressed in other sections of this document.

8.3.1.3. *Water*

Considering the limited period of time of construction activities and their typical non–continuous pattern, there is no permanent water discharge to be monitored.

No reporting activities are foreseen.

8.3.1.4. *Noise*

Noise emissions during construction phase are due to machinery equipment.

Work site machinery with combustion engines must be equipped with soundproofing measures if they are to be used within 50 m of the accommodation blocks.

8.3.1.5. *Waste*

Considering the limited period of time of construction activities and their typical non–continuous pattern, waste production is linked to the excavation activities.

No reporting activities are foreseen.

8.3.2. *Operation Phase*

8.3.2.1. *Air Quality*

Plant Emissioni Monitoring

Air emissions will be monitored, to guarantee the compliance with applicable limits.

Emissions from stacks during operation will be monitored, continuously, and recorded data will be available for national authorities. At each stack the following parameters will be measured:

- Temperature;
- Oxygen;
- humidity;
- Concentration of Nitrogen oxides;
- Concentration of Carbon Monoxide;
- Concentration of Sulphur oxides;
- Concentration of Suspended Particulate Matter.

Air Quality Monitoring

The impact on air quality of SO_2, NOx and PM_{10} emissions from the plant will be measured at a monitoring station, located in accordance to the Local Authorities' suggestions, in a residential area close to the plant.

The technical specifications for monitoring equipment will be in compliance with the requirements of relevant European Legislations.

An annual report with a synthesis of the emission data will be sent to the competent authority. The report will contain the information base set needed to evaluate compliance to applicable and relevant legislation.

8.3.2.2. *Soil*

The site area will be periodically checked through walk-around inspections, in order to ensure that roads and pavements will be kept in good conditions. Any damage or imperfection of the covered area will be promptly pointed out and repaired.

In any case, procedures and mitigation measures to avoid solid and liquid discharges onto the soil are addressed in other sections of this document.

No reporting activities are foreseen.

8.3.2.3. *Water*

The temperature of sea water discharge will be continuously monitored.

All regulated parameters for waste water discharge will be measured periodically.

Monitoring wells will be drilled around the Power Plant for periodic water analysis.

In addition, periodic sampling campaigns will be carried out in the area near the discharge point, in order to verify potential effects on marine biocenosis.

Together with the analysis of main physico-chemical parameters, the campaign will be specially focused on the monitoring of the most representative indicators of ecologic status of the marine water body (E.B.I. - Extended Biotic Index, Chlorophyll Dosage, etc), following the strategy of the Water Framework Directive (*Directive 2000/60/EC*) for the assessment of water bodies quality.

8.3.2.4. *Noise*

After starting Power Plant operation, extensive noise measurements will be performed at the most impacted receptors around the site. In case of limits exceedances, corrective actions will be defined.

The noise measures will be carried out following international standards (such as ISO) and results will be made available to the competent authority.

8.3.2.5. *Waste*

A detailed log of the waste produced (type, quantity, detailed source), shall be recorded.

Wastes will be disposed of by authorised companies in accordance with Albanian regulations.

At the end of every year, a report will be prepared, in order to control production trends and implement, if needed, appropriate reduction measures.