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4.0 ENVIRONMENTAL QUALITY

This section describes a variety of studies that were conducted to evaluate and describe the existing or baseline conditions of the environment that might be affected by this Project. The evaluation of the existing conditions in the study area focused primarily on atmospheric, noise levels, soil, water and marine sediment baseline conditions selecting parameters typically associated with industrial operations and in accordance to Peruvian and international standards. The study area comprises a wide, old high alluvial coastal terrace, south of the Rio Cañete valley. This coastal pampas is characterized by desert plains and low hills (dunes). This terrace is approximately 160 m high and is bounded to the west by coastal cliffs, to the east by the Panamerican Highway and to the north and south by plains and hills with similar characteristics, respectively.

The marine study area is comprised of the area extending from the coastline along the Project site to a depth of 16 m, located approximately 2.5 kilometers from the coast in a southeast direction.

The winds present a general pattern with a south-southeast to northern-northeast trend, resulting from the physiographic and oceanographic characteristics of the study area. The relative humidity of the area ranges from 82% to 88%, with minimum values recorded during the summer and maximum values recorded during the winter season.

The current system prevailing in the study area presents a marked south-north orientation, deriving basically from the influence of the Humboldt Current with general S-NNW orientation.

4.1 Air Quality

4.1.1 Existing Air Pollution Sources

The proposed LNG Export Project is located in a rural undeveloped area of Pampa Melchorita with no industrial users present within the study area and with the closest residential areas at approximately 4 km south of the Project site. The Panamerican Highway, located west of the Project site is the only source of emissions from vehicular traffic. The existing air quality at the site is considered representative of an area where the major source of air pollution is predominantly associated with a major highway and air borne particulate matter resulting from wind blown sediments.

4.1.2 Sampling Sites, Parameters and Methods

An air quality survey was performed at the site to evaluate baseline air quality in the study area at four (4) monitoring stations during consecutive 24-hour averaging periods. The survey included sampling of particulate matter less than 10 microns (PM_{10}), non-methane volatile organic compounds (VOC) nitrogen dioxide (NO_2), hydrogen sulfide (H_2S), carbon monoxide (CO) and sulfur dioxide (SO_2). The four monitoring locations were selected based on general prevailing wind directions. Two monitoring stations were located upwind and two downwind of the proposed facilities. The locations of the monitoring stations are presented in Map EQ-01 and respective coordinates are presented in Table 4-1. Air quality monitoring surveys were conducted on July 2002. The selected air quality parameters and analytical methods used for the evaluation are shown in Table 4-2. These air quality parameters chosen are those required by the Supreme Decree N° 074-2001-PCM, published on June 24, 2001 and with generally acceptable international standards.

Ambient Monitoring Methodology

A summary of the air quality monitoring data collected at the Project site is summarized in Table 4-3 and the ambient conditions present during the air quality survey are presented in Table 4-4. The levels for PM_{10}, SO_2, and NO_2 are consistent with background concentrations for rural areas and are representative of good air quality. The pollutants were monitored in accordance to the methodology presented in the following section. Details of the data collected and calibration of the PM_{10} monitoring equipment are presented in Appendix 2.

Samples collected were analyzed by ENVIROLAB, a laboratory certified by the Instituto Nacional de Defensa de la Competencia y Protección de la Propiedad Intelectual – INDECOPI (National Institute of Competency Defense and Protection of the Intellectual Property) (Resolution No.0054-2001/INDECOPI-CRT), the entity in Peru authorized to certify laboratories.

PM 10 and Non Methane Hydrocarbons

PM_{10} and non-methane hydrocarbon concentrations were measured using a Partisol FRM Model 2000 PM-2.5 sampling equipment manufactured by Rupprecht & Patashnick Con. Inc. and certified by ANSI Z540. The certificate of calibration for the sampler used is included in Appendix 2.

This air sampler operates at a low volume flow rate of 16.7 liters per minute and has a detection limit of 10 to 15 micrograms (µg) of total mass collected. Particles of aerodynamic diameter less than 10 µm bypass the impaction plate and are collected immediately downstream on a separator quartz-fiber filter. Filters were desiccated and weighed prior to and after sampling. Gravimetric analyses were performed using a precision digital electronic balance in the laboratory with 0.1 mg accuracy. Sample flow rate was checked before and after sampling using a flow meter that reads the actual flow. The average pre- and post-sample flow rates were corrected to estimate local atmospheric pressure and actual measured temperatures. The PM_{10} concentrations are reported in micrograms per cubic meters ($\mu g/m^3$) based on dividing the mass collected on each filter by the total sample volume. The sample volume is corrected to standard temperature and pressure conditions.

The air sampling equipment and filter were installed to protect the filter from precipitation, insects and other factors that might alter the sample quality in the filter. The generator used to power the equipment was situated far away from the sampler head to minimize the potential effects of emissions from the generator on the filter and sample quality.

NO_2, H_2S, CO and SO_2

NO_2, H_2S, CO and SO_2 gases were collected using a wet collection system or "bubbler" system. Each pollutant is collected by a specific absorbent solution, which is chemically altered in the presence of the pollutant. The resultant solution determines the sampled concentration of each pollutant.

These initial solutions are placed in separate sampling tubes and the air samples are drawn through the solutions using a metered air pump. The specific use of a bubbler sampling train is based on the knowledge that a bubbler-absorbent-flow rate combination will result in acceptable collection efficiencies. The sampling train consisted of:

- Orion Air sampling pump;
- Cole-Parmer rotameter, range 0 to 2 L/min;
- Air filter;
- Teflon tubing;
- 100 mL Pyrex bubbler tubes.

In addition to the bubbler sampling train, local atmospheric data was collected using:

- Digital Biochemical Instruments barometer – thermometer;
- Wind vane;
- Chronometer; and
- Electrical power.

The bubbling of the sample through the absorbent solutions was controlled by the rotameter that determined the sample air volume and the specific duration of sampling for each gas sample was noted.

For the NO_2 sampling, 50 ml of sulphanilic acid was put in the absorption tube and the airflow was regulated from 0.19 L/min to 0.2 L/min by the differential rotameter at the end of the sampling apparatus. The total sampling time for each sample was 24 hours. The collected sample was placed in a plastic vessel and preserved in a cooler for later analysis in the laboratory. The initial and final flows were recorded to estimate the average flow in each sample.

For the H_2S sampling, 50 ml of a cadmium hydroxide suspension in alkaline solution was placed in the absorption tube at an airflow of 1 L/min. The sampling time was 3 hours. The collected sample was placed in a plastic vessel and preserved in a cooler for later analysis in the laboratory.

For the SO_2 sampling, 50 ml of absorbent solution of 0.04 sodium tetrachloromercurate was placed in the absorption tube and the airflow was adjusted to 0.2-0.25 L/min during the 24-hour sampling time. The collected sample was placed in a plastic vessel and preserved in a cooler for later analysis in the laboratory.

For the CO sampling, a 10 ml solution containing the following mixture, 20 ml of p-sulphaminobenzoic acid, 20 ml of 0.1 M silver nitrate, and 10 ml of 0.1 M NaOH was used. The sample is bubbled through the mixture at a sampling flow of 1 L/min for 8 hours. The collected sample was placed in a plastic vessel and preserved in a cooler for later analysis in the laboratory.

The sample airflow rates were recorded and checked for each event. Meteorological parameters like temperature, relative humidity, pressure, wind speed and direction were recorded as well.

4.1.3 Ambient Monitoring Results

A summary of the air quality monitoring data collected at the project site is summarized in Table 4-3 along with applicable environmental guidelines and standards approved by Peru and the World Bank (General Environmental Guidelines – Pollution Prevention and Abatement Handbook, WORLD BANK GROUP) for air quality. The levels for PM_{10}, SO_2, and NO_2 are consistent with background concentrations for rural areas and are representative of good air quality. The pollutants were monitored in accordance to the methodology presented in the following section. Details of the data collected and calibration of the PM_{10} monitoring equipment are presented in Appendix 2.

The results of the baseline air quality monitoring are discussed below and compared with ambient air quality standards used.

Particulate (PM_{10})

As shown on Table 4-3, the maximum 24-hour average PM_{10} ambient air quality background concentration recorded at the Project site ranged between 33 $\mu g/m^3$ and 71 $\mu g/m^3$. The background concentration of 71 $\mu g/m^3$ complies with the Peruvian Standard (150 $\mu g/m^3$); however, it is above 70 $\mu g/m^3$, value recommended by the World Bank. The higher concentrations of PM_{10} were measured at stations AM-01 (62 $\mu g/m^3$) and AM-03 (71$\mu g/m^3$). These monitoring stations were located in relatively flat areas near hills that provided little protection from wind blown particulate matter from the coast. High concentration of particulate matter is common along the Peruvian coast, according to the environmental database of the General Directorate of Environmental Affairs of the Ministry of Energy and Mines. Annual PM_{10} concentrations recorded in Ilo Port (located to 1,000 km approximately to south) ranged up to 114 $\mu g/m^3$ with an average concentration of 70 to 75 $\mu g/m^3$ and up to 117$\mu g/m^3$ at Callao with an annual average ranging between 80 and 85 $\mu g/m^3$. These stations are both located upwind of the proposed Project.

Carbon Monoxide (CO)

As presented in Table 4-3 the maximum 24-hour average CO ambient air quality background concentration recorded at the Project site was 381$\mu g/m^3$ at the AM-02 station and 390 $\mu g/m^3$ at the AM-04 station. These stations were both located in elevated areas of the site and are likely influenced by emissions from vehicles traveling on the Panamerican Highway located east of the Project site.

The CO background concentrations recorded are below the Peruvian 24-hour ambient air quality standards (30,000 µg/m^3). The World Bank does not have a 24-hour guideline for ambient CO concentration.

Nitrogen Oxide (NO_2)

The maximum 24-hour NO_2 ambient air quality baseline concentration recorded at the Project site were all below the laboratory detection limit (3 µg/m^3) with the exception of the NO_2 concentrations recorded at monitoring station AM-01 which was4 µg/m^3. Peruvian 24-hour ambient air quality standard is 200 µg/m^3 and the World Bank Guideline of 150µg/m^3.

Sulfur Dioxide (SO_2)

The baseline SO_2 concentrations recorded were all below the laboratory detection limit (5 µg/m^3). The Peruvian ambient air quality standard for SO_2 is 365 µg/m^3 and the World Bank Guideline is 125µg/m^3.

Non-Methane Hydrocarbon (NMHC) and Hydrogen Sulfide (H_2S)

The 24-hour ambient air quality concentration recorded for NMHC and H_2S were below the laboratory detection limit (1 µg/m^3 for NMHC and 3 µg/m^3 for H_2S). Neither Peru nor the World Bank has ambient air quality standards or guidelines for NMHC and H_2S concentrations.

4.2 Noise

Noise is defined as the intensity, duration and character of unwanted or nuisance sounds from sources of human activities that can impact workers or the general public's well-being or health. The level of impact is related to the magnitude of the noise, which is referred to as sound pressure level (SPL) and measured in decibels (dB).

Decibels are calculated as the logarithmic function of SPL in the air to a reference sound pressure, which is considered the hearing threshold, or:

$$SPL = 20 \log_{10} (Pe/Po)$$

Where: Pe = measured sound pressure of sound wave in micropascals (µPa), and

Po = reference sound pressure of 20 µPa.

To account for the effect on how the human ear perceives sound pressure, at moderate to low levels, the octave band frequency (pitch), measured in cycles per second or hertz (Hz), is adjusted or weighted. One of the most commonly used and accepted frequency weightings is the A-weighted (dBA) filter, that adjusts the measurements for the approximated response of the human ear to low frequency SPLs (i.e., below 1,000 Hz) and high-frequency SPLs (i.e., above 1,000 Hz). These measurements are known as "A-weighted decibels" referred to as dBA in this EIA.

4.2.1 Noise Monitoring and Methodology

A baseline noise monitoring survey was performed in the area of the proposed Project and nearest public receptors. Five 24-hour monitoring surveys were conducted, three within the Project area and two at the nearest receptors.

The baseline noise surveys conducted at the nearest receptors are located in the summer residential unit known as Wakama and the illegal settlement of Nuevo Ayacucho, located approximately 6 km and 4 km south of the project area, respectively. Table 4-5 presents the coordinates of the sites selected for the noise monitoring and Map EQ-01 presents the geographic locations.

The baseline noise monitoring was undertaken on September 28, 29, 30 and October 1 at monitoring locations: NM1, NM2 and NM3 sites and on October 5, 6 and 7, 2002 at the Nuevo Ayacucho and Wakama sites.

The noise monitoring equipment used during the survey included:

A Class 1 sound meter was used under the low response mode to obtain the integral of the noise pressure levels of A-weighting and frequency data of 1/3 octaves. The device was programmed to measure levels equivalent (Leq) to intervals of 15 minutes during a complete 24-hour period measuring per site, which provided a total of 97 records by site.

The sound meter used to measure consisted of the following components:

1. Equipment for Continuous Noise Measurement
    a. Delta Ohm, model HD 9019 Integrating Type I Sound Level Meter
    b. HD 9019S/1, Class 1 Microphone Preamplifier
    c. MK221 Model Condenser Microphone

d. Windscreen, tripod and various cables

2. Sound Level Calibration Unit

a. Delta Ohm HD 9101 Model Noise Level Calibrator, 94/114 dB at a frequency at 1,000 Hz.

The Delta Ohm HD 9019 sound level meter complies with the IEC 651 (CEI EN 60651/1994) and IEC 804 (CEI EN 60804/1994) standards for Type I precision instruments. The band filters of 1/3 octave are under the IEC 1260 (CEI EN 6126/1995) standards for Class 2. The calibration certificates for both equipment components are presented in Appendix 2.

The sound level meter used to monitor the noise levels operated in a slow response mode to obtain accurate, integrated, A-weighted sound pressure levels. All measurements were taken outdoors and a windscreen was used to alleviate any possible measurement errors due to wind effects across the microphone face. The microphone was mounted on a tripod at a height of 1.5 meters above grade and positioned at a 45-degree angle, as specified by ANSI standards, and was powered by a 9-volt external power source. The sound level meter and octave band analyzer were calibrated immediately prior to and immediately after the sampling period to provide a quality control check of the sound level meter operation during monitoring. Integrated sound pressure level (SPL) data consisting of the following parameters were collected at each location. L_{eq} is the SPL averaged over the measurement period. This parameter is the continuous steady sound pressure level that would have the same acoustic energy as the real fluctuating noise over the same time period.

Max The maximum SPL for the sampling period; and

Min The minimum SPL for the sampling period.

L_{eq} The SPL averaged over the measurement period; this parameter is the continuous steady sound pressure level that would have the same acoustic energy as the actual fluctuating noise over the same time period;

Max The maximum SPL for the sampling period; and

Min The minimum SPL for the sampling period.

Local wind speed and temperature were noted during each noise-monitoring period. Detailed field notes were recorded during monitoring and included in the local meteorological parameters and major noise sources.

4.2.2 Noise Regulations and Criteria

For the evaluation of the environmental quality of the study area related to the noise, data obtained in each measured site were compared to the World Bank Guidelines since there were no Peruvian standards.

The maximum L_{eq} (hourly), as A-weighted dB, was measured during the daytime and the nighttime. For residential, institutional, and educational receptors, the daytime and nighttime guidelines are 55 and 45 dBA, respectively. For industrial and commercial receptors, the daytime and nighttime guidelines are 70 dBA based on hourly measurements as described below. Instead of the specific ambient noise guidelines for land use receptors, a maximum increase of 3 dBA over background levels is also allowed by the World Bank Guidelines.

The World Bank has developed noise guidelines regarding average hourly noise levels that were designed to protect the general public. These guidelines are split between two distinct land uses: 1) residential, institutional, and educational, and 2) industrial and commercial. Maximum L_{eq} (hourly), as A-weighted dB, during the daytime and the nighttime have been established.

Receptor	Hour	L_{eq} (per hour) Maximum Permissible dBA
Residential; Institutional and Educational	7 a.m. — 10 p.m.	55
	10 p.m. — 7 a.m.	45
Industrial and Commercial	7 a.m. — 10 p.m.	70
	10 p.m. — 7 a.m.	70

The equivalent noise pressure level for the period recorded was calculated according to the following formula:

$$\text{Average Leq SPL} = 10 \log \frac{\sum_{i=1}^{N} 10^{(SPL_i/10)}}{N}$$

where: L_{eq} = equivalent noise pressure level (dBA)

SPL_i = single noise pressure levels (dBA) in the data

N = number of observations in the period recorded

Table 4-6 shows a summary of L_{eq} values recorded in each site selected for the noise evaluation (In Appendix 2 shows the most significant events observed during the noise record). Figures 4-1 to 4-6 show distribution graphics of the results.

The results of the 24-hour noise surveys conducted at the project site and at the closest receptors are indicated that the daytime noise levels (L_{eq}) observed at the monitoring locations within the project area (NM1 and NM3) ranged from 40 dBA at NM1 to 43 dBA at NM3; while the nighttime noise levels (L_{eq}) observed ranged from 29 dBA at NM3 to 30 dBA at NM1. The results of the noise survey at the NM2 site (considered a Project perimeter survey) ranged 64 dBA during the day and 62 dBA at night. The results of NM2 generally reflect noise levels resulting from traffic on the Panamericana Sur Highway located on the boundary east of the Project area and close to the highway.

The results of the 24-hour noise monitoring at the closest residential receptors (Wakama and Nuevo Ayacucho) to the Project site, located 6 and 4 km to the south, respectively recorded a daytime (L_{eq}) noise levels of 55 dBA at Nuevo Ayacucho and 57 dBA at Wakama. The nighttime (L_{eq}) noise levels recorded ranged 53 dBA at Nuevo Ayacucho and 58 dBA at Wakama. The results at these residential receptors reflect noise levels associated with traffic on the Panamerican Sur Highway particularly at the Nuevo Ayacucho monitoring location. The noise levels recorded at the Wakama site had significant influence from the strong waves crashing on the coastal cliffs.

The World Bank Guidelines suggest that the noise abatement measures should achieve either the maximum allowable noise level (L_{eq}) designated for land use receptors for daytime and nighttime hourly measurements or a maximum increase in the background noise levels of 3 dBA. The results of the noise monitoring indicate that the existing noise levels at the residential receptors; Ayacucho and Wakama are impacted by noise from the Panamerican Sur Highway and the intense wave action crashing on the coastal cliffs. The noise levels observed at Wakama and Nuevo Ayacucho were in

excess of the land use receptor noise guidelines for almost all of the hourly readings at nights and certain hours during the day. As a result, the appropriate noise criteria for the Project is the maximum increase in background of 3 dBA at the land use receptors.

4.3 Soils

4.3.1 Sampling Sites, Parameters and Methods

Soil conditions at the study area were evaluated to characterize potential environmental soil contamination resulting from past land use activities at the Site. Soil sampling was conducted at two (2) representative locations at the Site and the samples obtained were analyzed for heavy metals and total petroleum hydrocarbons (TPH). The selections of the sampling locations were based on topography, drainage patterns, and the proposed location of future facilities (i.e., storage tanks and process equipment), where the potential exist of impacting site soil conditions during the operations of the Project. The soil sampling locations are presented in Map EQ-01 and the UTM coordinates are shown in Table 4-7.

Table 4-8 presents the analytical parameters selected for evaluation and the analytical methods.

Two rounds of soil sampling soil were conducted. The first sampling event was conducted on June 21, 2002, and the samples collected were analyzed for TPH and heavy metals. The soil samples analyzed during the second sampling event conducted on August 04, 2002 were limited to parameters that had elevated concentrations during the first sampling event such as lead, arsenic and chromium.

ENVIROLAB Laboratory, certified by the INDECOPI (Resolution No.0054-2001/INDECOPI-CRT), the certifying entity in Peru analyzed all the samples.

4.3.2 Soil Analytical Results

The analytical results from this assessment are presented in Table 4-9. A copy of the laboratory certifications is presented in Appendix 2.

Due to absence of specific numerical soil quality standards in Peru, international Soil Cleanup Targets Levels (SCTL) were used for comparing the results of the analysis to the following standards:

- The Canadian Council of Ministers of the Environment (CCME, 1999) environmental quality guidelines for industrial land use; and
- The Water Federal Work Group of Germany (Länderarbeitsgemeinschaft Wasser - LAWA, 1994) for the investigation, evaluation and remediation of groundwater.

The soil analytical results indicate that TPH concentrations detected in the soil samples analyzed were below the detection limit of the analytical method used (8 mg/kg). The SCTL for TPH ranges from 1,000 and 5,000 mg/kg using the above referenced international standards.

The soil analytical results also indicate that cadmium, mercury and nickel concentrations in the soil samples were below the detection limit of the analytical method used (0.15 mg/kg; 0.10 mg/kg and 0.15 mg/kg, respectively).

The soil analytical results indicate that copper (14. mg/kg – 28.0 mg/kg), chromium (11.16 mg/kg – 27.97 mg/kg), lead (6.3 mg/kg – 15.90 mg/kg) and zinc (24.6 mg/kg – 29.1 mg/kg) all had detectable concentrations below the SCTL established by the CMEE (91 mg/kg, 87 mg/kg, 600 mg/kg and 360 mg/kg, respectively).

The soil analytical results indicate that arsenic concentrations detected in the soil sample analyzed ranged from 8.22 mg/kg to 12.03 mg/kg, below and slightly above the CCME industrial SCTL of 12 mg/kg.

The metal concentrations detected in the soil samples analyzed are representative of natural background concentrations found in the general area. A literature review of metal concentrations encountered in soils of Pampa Melchorita area and at other locations indicate that metal concentrations encountered in the study area are in the magnitude of those found worldwide or in some cases (chromium and zinc) are considerably lower.

Parameters	Concentrations (mg/kg)			
	Average Worldwide (Koljonen, 1992)	Agriculture Studies (Reimann and Caritat, 1998)	Peruvian Coast Studies (Golder, 2000)	Project (Golder, 2002)
Arsenic	5	1.5 – 6.6	8 – 13.6	8.2 - 12
Copper	25	12.8 – 19	32.9 – 62.7	14.1 – 28
Chromium	80	19.1 – 39.3	6.14 – 31.4	11.2 – 27.9
Lead	17	12.8 – 19	25 – 47.5	6.3 – 15.9
Zinc	70	16.3 - 82	67.1 – 105.9	24.6 – 29.1

4.4 Seawater Water Quality

4.4.1 Sampling Stations and Monitoring Parameters

To evaluate and classify the baseline water quality conditions at the proposed site for the marine facilities, samples were collected at 13 sampling stations on July 14, 2002, during autumn and on October 6, 2002 during spring. These samples were collected using standard methodology established in the Golder Associates Comprehensive Quality Assurance Plan. Samples were collected as described below:

The monitoring stations selected to evaluate water quality conditions consisted of four transects designated as T2, T3, T4 and T5, located perpendicular to the coast and parallel to the proposed location planned for the trestle. At each station, samples were collected at three levels; 1 m below the surface, medium depth, and slightly above the sea bottom. Transects relative to the location of the trestle are presented below:

- T2 located 500 m to the south of the centerline of the proposed trestle;
- T3 located at the centerline of the proposed trestle;
- T4 and T5 located at 500 m and 800 m north of the centerline of the trestle, respectively.

The location of the stations in each of the above mentioned transects were determined according to the bathymetry available for the area, at 10 m, 12 m and 16 m deep, respectively. The UTM (Datum WGS84) coordinates of each sampling station and sample depth are presented in Table 4-10 and illustrated in Map EQ-02.

Ten stations were sampled during the autumn sampling event and six stations during the spring sampling event. The number of sampling stations and parameters evaluated during the spring sampling event were reduced to those that showed detectable levels for established parameters during the autumn sampling event.

A boat was used to reach that particular site. The samples were collected by means of a 5-litre PVC Niskin bottle. After lowering the sampler to the sampling depth established, a sinker was dropped manually along the line, which activated the opening device, thus allowing the extraction of a representative water sample at that particular depth. The sampler was returned to the surface and the

water sample was poured directly into vessels containing appropriate preservatives and especially prepared by the laboratory

Each of the vessels used was exclusively prepared for a particular analytical parameter consistent with the methodology and protocol established by the laboratory. Each of the vessels was labeled and marked with an exclusive sample code number to simplify follow-up and individual identity of the vessels. The samples were then sealed and placed in ice and cooled to approximately 4 °C in a refrigerator insulated and protected by hard polyethylene walls. Chain of Custody (COC) register was prepared and the integrity and security of the samples were maintained at all times. The samples were placed in ice and hand transported to the laboratory. Before transporting the samples to the designated laboratory, a security seal was placed on the lid of the refrigerator. The seal remained intact during transit. The samples were placed in containers and in accordance to the specifications presented below:

Parameter	Sample quantity	Receptacle	Preservative
TPH	1 L	Glass bottle	None
Metals	1 L	Plastic bottle	1,25 ml of HNO_3 (1:1)
TDS, Bicarbonates, Chloride, Fluoride and Sulfate	½ L	Plastic bottle	None
Detergents	½ L	Plastic bottle	None
Nitrate	250 ml	Plastic bottle	0,5 ml of H_2SO_4 (1:1)
Cyanide	1 L	Plastic bottle	1 pellet of $NaOH_{(s)}$

Table 4-11 presents the parameters and analytical methods utilized during the laboratory analysis. The parameters were selected according to both national and international marine water quality standards. For certain parameters, random duplicate samples were taken, in order to secure accuracy at the laboratory and to confirm reproducibility of the analytical methods utilized. Three duplicate samples were collected and submitted to the laboratory during the autumn sampling event and 2 duplicates samples during the spring sampling event. The results of duplicate analyses were used to validate the data by using relative percent difference (RPD) defined as the percent of the difference between the test result and the duplicate divided by the sum of the same; expressed as a percent. Although a few parameters analyzed had a high RPD, it was mainly attributed to the low

concentrations associated with the parameters analyzed. These parameters are within the range of concentration analyzed and are considered representative of the media evaluated. The results of the RPD evaluation are presented in Appendix 2. All Samples were analyzed in Envirolab.

A quality control and assurance system was implemented during the water quality sampling of seawater.

4.4.2 Seawater Quality Results and Analysis

The results of the physical-chemical data for the 2002 autumn and spring sampling events are presented in Table 4-12 and Table 4-13 respectively. Appendix 2 includes the complete results of the laboratory results as reported by the ENVIROLAB laboratory and the results of the quality control samples.

The analytical results of seawater baseline were compared to the National Standards for Water Environmental Quality, established in the Water General Law (Law N° 17752) for Use VI (Zones of preservation of aquatic fauna and recreational or commercial fishing). In the absence of specific numerical standards in the Law N° 17752 for parameters such as pH, copper, nickel and zinc, the environmental quality standards established in the Water Quality Guidelines of British Columbia, Canada (BC, 2000) and the water quality standards established by United States EPA (USEPA, 1999) were used, since the World Bank does have not have environmental water quality guidelines, but rather allowable effluent limits.

The water quality results of the baseline, the comparison with applicable environmental standards and the analysis of autumn and spring samplings are discussed below.

Physical -Chemical Parameters

The physical chemical parameters of seawater were evaluated from samples collected during a two season sampling event at locations described in section 4.4.1 and analyzed for pH, conductivity, total dissolved solids (TDS) and total suspended solids (TSS). TSS was not evaluated during the spring sampling event.

The results of the analysis indicate that total suspended solids during the autumn and spring sampling event are below the analytical detection limit (5 mg/l). Total dissolved solids during the autumn

sampling event ranged from 32,800 mg/l to 37,600 mg/l, while the spring event ranged between 37,200 mg/l and 40,600 mg/l, which are considered typical values for seawater. The conductivity during the autumn sampling was fairly constant in all samples, with concentrations ranging between 52.60 mS/cm and 53.00 mS/cm; while the spring sampling concentrations were slightly higher and ranging from 52.80 mS/cm and 53.95 mS/cm respectively. The pH value in autumn samples ranged from 7.55 to 8.01; with a slight variation in the spring with pH values ranging from 7.46 to 8.38. The pH values during both sampling events were between the 6.50 to 8.50 range established by EPA for seawater.

Ions

The primary ions evaluated in the baseline characterization of seawater samples collected were bicarbonates, chloride, fluoride, N-nitrates, sulphates and total cyanide. Sulphate and total cyanide were not evaluated during the spring sampling event. No applicable water quality standards for ions are available.

The laboratory results indicate that the concentration of bicarbonates and chloride of samples analyzed during both sampling events showed that bicarbonates range during the autumn event ranged from 116.4 – 124.7 mg/l, and during the spring event from 113.2 – 129.2 mg/l; while chloride concentrations ranged from 18,894 mg/l to 19,994 mg/l during autumn and 19,452 mg/l to 19,954 mg/l during spring.

The concentrations of Fluorides and N- Nitrates demonstrated an opposite pattern in comparison to the parameters previously described, in that the concentrations had a slight decrease from autumn to spring. Fluoride concentration in autumn ranged from 0.91 mg/l and 0.96 mg/l while in spring the concentration ranged from 0.44 mg/l to 0.49 mg/l. The N-Nitrates ranged 0.17 to 0.48 mg/l in autumn and 0.10 mg/l to 0.55 mg/l in spring.

The results of the analysis indicate that the average sulfate concentration in the autumn samples evaluated was 2,515 mg/L and the maximum concentration was 2,797 mg/L.

The concentration of total cyanide in all autumn samples analyzed was below the detection limit (0.004 mg/l) and below the environmental quality standard of the Water General Law (Use VI) is 0.005 mg/l.

Organic Parameters

The organic parameters evaluated during the baseline characterization of seawater quality included detergents, phenol, oil and grease, and total petroleum hydrocarbons (TPH) during the autumn sampling event and TPH only during the spring sampling event.

The concentrations of detergent, phenol, oil and grease, and TPH in all samples analyzed were below the analytical detection limit of 0.06; 0.1; 5 and 0.2 mg/l, respectively. Of all the organics analyzed, phenol is the only parameter where the General Water Law (Use VI) has established numerical standards of 0.100 mg/l. .

Total Metals

The selected metals analyzed during the autumn and spring sampling events are presented in Table 4-12 and Table 4-13 along with the corresponding laboratory detection limits. The results of the metal analyzed during both sampling events indicated that all the metals analyzed are either below the analytical detection limit or comply with the requirements of the Water General Law for Use VI (Aquatic Life Protection) where numerical standards exists or International standards with the exceptions noted below. Laboratory results indicate that the analytical detection methods for mercury and cadmium are slightly higher than the values established by the Water General Law Environmental Quality Standards used. In addition, there are no established allowable concentrations levels for copper, zinc and nickel in the Water General Law (Use VI – Aquatic Life Protection).

EPA has established Criteria Continuous Concentration (CCC), the highest concentration to which organisms can be exposed indefinitely without causing unacceptable effect for various organic and inorganic parameters. The CCC for the following metals evaluated for this study are: copper (0.0031 mg/l), nickel (0.00081mg/l) and zinc (0.081 mg/l).

The concentrations recorded in both autumn and spring sampling events, for mercury, arsenic, cadmium, lead and zinc were all below the EPA CCC. However, the laboratory detection limits for cyanide, nickel and copper were higher than the CCC. The remaining parameters are below the CCC.

The guide values for water quality approved by British Columbia for the marine aquatic life are: for copper 0.003 mg/l, nickel 0.075 mg/l and zinc 0.010 mg/l. In relation to the previous ones, the nickel values recorded in the samples are below this standard. On the other side, the copper values recorded

in the 2002 autumn and spring samples exceed the water quality guide values established by British Columbia. Similarly the zinc values recorded in autumn (between 0.020 mg/l and 0.103 mg/l) and in spring (between 0.015 mg/l and 0.083 mg/l) would exceed this standard. It should be noted that the British Columbia standard for zinc was established for freshwater, in this report it is used as a reference since there is no other criteria for zinc.

For copper, in the 2002 autumn some values recorded exceeded the environmental standards reviewed; while 2002 spring values are all below the detection limit being higher than the standard. Having in mind that since there is no known copper source in the area, it can be assumed that these concentrations correspond to natural concentrations in the studied area.

4.5 Marine Sediments

4.5.1 Sampling Stations and Monitoring Parameters

To evaluate and classify the baseline marine sediment conditions at the proposed site for the marine facilities samples were collected at 13 sampling stations on July 14, 2002, during autumn and on October 6, 2002 during spring. These samples were collected using standard methodology established in the Golder Associates Comprehensive Quality Assurance Plan. Samples were collected at the same four transects (T2, T3, T4 and T5) where samples to evaluate the physical-chemical parameters of seawater water quality were collected.

The UTM (Datum WG84) coordinates of each sampling station and sample depth are presented in Table 4-14 and illustrated in Map EQ-02.

Ten stations were sampled during the autumn sampling event and six stations during the spring sampling event. The number of sampling stations and parameters evaluated during the spring sampling event were reduced to those that showed detectable levels for established parameters during the autumn sampling event.

A boat was used to reach that particular site. The samples were collected using a Van Veen dredge with a dredging capacity up to 4 kilograms and a sampling surface of 25 x 25 cm^2. The material collected was returned to the surface and the water was drained from the sample and approximately 500 grams of sediments were placed into polyethylene bags. Each bag were hermetically sealed, labeled and marked with an exclusive sample code number to simplify follow-up and individual

identity of the sample. The samples were then placed in ice and cooled to approximately 4°C in a refrigerator insulated and protected by hard polyethylene walls. Chain of Custody (COC) register was prepared and the integrity and security of the samples were maintained at all times. The samples were placed in ice and hand transported to the laboratory. Before transporting the samples to the designated laboratory, a security seal was placed on the lid of the refrigerator. The seal remained intact during transit.

Table 4-15 presents the parameters and analytical methods utilized during the laboratory analysis. Parameters were selected according to both national and international sediment standards. For certain parameters, random duplicate samples were taken, in order to secure accuracy at the laboratory and to confirm reproducibility of the analytical methods utilized. Two duplicate samples were collected and submitted to the laboratory during the autumn sampling event and 1 duplicate sample during the spring sampling event. The results of duplicate analyses were used to validate the data by using relative percent difference (RPD). Although a few parameters analyzed had a high RPD, it was mainly attributed to the low concentrations associated with the parameters analyzed. These parameters are within the range of concentration analyzed and are considered representative of the media evaluated. The results of the RPD evaluation are presented in Appendix 2.

The samples were sent for analysis to the Envirolab Perú Laboratory, certified by INDECOPI, certifying entity in Peru. Envirolab Perú was certified through Resolution Nº 0054-2001/INDECOPI-CRT.

4.5.2 Results and Analysis

The results of the sediment analyses for the 2002 autumn and spring sampling events are presented in Table 4-16 and Table 4-17, respectively. Appendix 2 includes the complete results of the laboratory results as reported by the Envirolab Laboratory and the results of the quality control samples.

The results of marine sediment baseline analytical results were compared to the Environmental Quality Guidelines of the Canadian Council of Ministers of the Environment (CCME, 1999) in the absence of specific numerical standards in Peruvian regulations. The results of the baseline marine sediment results and the comparison with applicable environmental standards are discussed below.

The marine sediments were evaluated from samples collected during a two season sampling event at locations described in section 4.5.1 and analyzed for TPH and metals.

The results of the analysis indicate that TPH during the autumn and spring sampling event are below the analytical detection limit (8 mg/l).

The selected metals analyzed during the autumn and spring sampling events are presented in Tables 4-16 and 4-17 along with the corresponding laboratory detection limits. The results of the metal analyzed during both sampling events indicated that all the metals analyzed are either below the analytical detection limit or the established international standards with the exceptions noted below.

Concentration of arsenic during the autumn sampling event at station T3-16 exceeded the established standard. As shown in Table 4-16 and Table 4-17, the results of the analyses indicate that arsenic ranged from 1.94 mg/kg to 13.64 mg/kg during the autumn sampling event and from 7.16 mg/kg to 10.29 mg/kg during spring sampling event. The arsenic concentrations measured represent natural background conditions that have been found in other parts of the world. Published data on arsenic indicate that sediments in Europe have been recorded with arsenic concentrations ranging between 0.05 mg/kg and 57.6 mg/kg in Norway; 22 mg/kg and 334 mg/kg in the Harz region in Germany and between 12 mg/kg and 150 mg/kg in Scotland (Reimann, Caritat, 1998). Concentrations ranging from 8.01 mg/kg and 13.62 mg/kg (Golder, 2000) have been recorded in Peruvian coastal soils.

The laboratory results indicate that the maximum cadmium concentration recorded during the 2002 autumn sampling event was 2.93 mg/kg and during the spring sampling event, cadmium concentrations ranged from 1.95 mg/kg to 2.53 mg/kg, a factor of 10 lower that the international criteria of 22 mg/kg. The chromium concentrations recorded during the autumn sampling event ranged from 4.47 mg/kg to 20.07 mg/kg, and during the spring sampling event ranged from 5.53 mg/kg to 7.41 mg/kg. The concentrations for chromium were below the international sediment quality criteria of 87 mg/kg. The analyses conducted on samples during the autumn sampling event indicates concentrations of copper in sediments ranging from 8.0 mg/kg to 19.3 mg/kg, and 8.70 mg/kg to 19.0 mg/kg during the spring sampling event. The results of both season events were below the international quality criteria of 91 mg/kg. Nickel concentrations registered during the autumn sampling event were below the detection limit (0.50 mg/kg), and during the spring event ranged from 2.6 mg/kg to 3.5 mg/kg, which were both below the international quality criteria of 50 mg/kg.

Lead concentrations varied from 29.3 mg/kg to 85.5 mg/kg during autumn and from 8.5 mg/kg to 10.8 mg/kg during spring, both below the international criteria of 600 mg/kg.

Zinc concentrations measured during both sampling seasons were also below the international criteria of 360 mg/kg. The concentrations varied from 23.02 mg/kg to 47.83 mg/kg during autumn and from 23.07 mg/kg to 40.06 mg/kg during the spring. Mercury concentrations in all samples analyzed were below the detection limit of 0.10 mg/kg and below the international criteria of 50 mg/kg.

TABLES

Table 4-1. Air Quality Sampling Sites Coordinates

Name	UTM Coordinates	
	North	East
AM-01	8 534 940	359 116
AM-02	8 534 616	359 780
AM-03	8 535 697	359 776
AM-04	8 536 170	359 250

Table 4-2. Parameters and Analytical Methods performed for Air Quality Sampling

Parameter	Analytical Method	Method Detection Limit
PM-10	EPA 40 CFR Part 50 Appendix J	- $\mu g/m^3$
H_2S	Spectrophotometry	3 $\mu g/m^3$
NO_2	Spectrophotometry	3 $\mu g/m^3$
SO_2	EPA 40 CFR Part 50 Appendix A	5 $\mu g/m^3$
Hydrocarbons (No Methane)	Soxhlet gravimetry	1 $\mu g/m^3$
CO	Spectrophotometry	2 $\mu g/m^3$

Table 4-3. Air Quality Sampling Results

Parameter	Unit	Site				Environmental Quality Standards	
		AM-01	AM-02	AM-03	AM-04	Peru [1)]	World Bank [2)]
H_2S	$\mu g/m^3$	< 3	< 3	< 3	< 3		
CO	$\mu g/m^3$	293	381	313	390	30 000	
SO_2	$\mu g/m^3$	< 5	< 5	< 5	< 5	365	125
NO_X	$\mu g/m^3$	4	< 3	< 3	< 3	200	150
PM-10	$\mu g/m^3$	62	33	71	33	150	70
NMHC	$\mu g/m^3$	< 1	< 1	< 1	< 1		

Notes:

[1)] D.S. N° 074-2001-PCM (published 24.06.01). Valid values for 24 h-average.
[2)] World Bank Group, Pollution Prevention and Abatement Handbook. Valid values for 24 h-average.

Table 4-4. Meteorological Parameters for Air Quality Sampling

Sampling Site	Sampling Date	Sampling Hour	Temperature (°C)	Relative Humidity (%)	Wind Velocity (Km/h)	Predominant Wind Direction (From)
AM-01	02/07/05	13:50	25	55	8.3	W-E
		16:50	19	71	13.0	W-E
		18:20	16	82	6.5	W-E
		20:00	15	83	5.4	N-S
		22:00	13	86	5.4	N-S
	02/07/06	00:00	13	86	4.3	N-S
		02:00	11	84	8.3	N-S
		04:00	16	83	10.8	N-S
		06:00	16	85	11.9	W-E
		08:00	16	85	7.6	SW-NE
		10:00	17	80	5.8	W-E
		12:00	18	73	5.0	SW-NE
		13:50	18	77	5.0	SW-NE
AVERAGE			16	79	7.5	
AM-02	02/07/06	16:00	16	84	11.2	SW-NE
		18:00	15	87	9.0	SW-NE
		20:00	15	90	10.4	NW-SE
		22:00	14	92	5.4	N-S
	02/07/07	00:00	15	88	4.3	N-S
		02:00	15	87	9.4	N-S
		04:00	14	89	11.5	N-S
		06:00	14	90	11.5	W-E
		08:00	15	88	7.9	SW-NE
		10:00	16	83	4.3	SW-NE
		12:00	17	77	4.0	W-E
		14:00	21	57	5.4	SW-NE
		16:00	15	92	6.5	SW-NE
AVERAGE			16	85	7.8	
AM-03	02/07/06	13:00	19	64	12.6	S-N
		16:00	22	58	8.3	S-N
		18:00	16	82	5.0	W-E
		20:00	15	83	5.4	N-S
		22:00	13	86	5.4	N-S
	02/07/07	00:00	13	86	4.3	N-S

Sampling Site	Sampling Date	Sampling Hour	Temperature (°C)	Relative Humidity (%)	Wind Velocity (Km/h)	Predominant Wind Direction (From)
		02.00	11	84	8.3	N-S
		04:00	16	83	10.8	N-S
		06.00	16	85	10.8	W-E
		08.00	16	84	9.0	SW-NE
		09:45	16	84	9.0	SW-NE
		11.55	17	80	7.6	W-E
		13:00	17	73	9.4	SW-NE
	AVERAGE		16	79	8.1	
AM-04	02/07/06	15:00	16	78	4.7	SW-NE
		16:00	16	84	10.4	SW-NE
		19:30	15	87	9.0	SW-NE
		20:00	15	90	10.4	NW-SE
		22:00	14	92	5.4	S-N
	02/07/07	00:00	15	88	4.3	S-N
		02:00	15	87	9.4	S-N
		04:00	14	89	11.5	S-N
		06:00	14	90	11.5	W-E
		08:00	15	88	7.9	SW-NE
		10:00	16	83	4.3	SW-NE
		12:00	17	77	4.0	W-E
		14:00	21	57	5.4	SW-NE
		15:00	15	92	6.5	SW-NE
	AVERAGE		16	84	7.5	

Table 4-5. Noise Measurement Sites Coordinates.

Station	UTM Coordinates		Location
	East	North	
NM1	358862	8535703	NW to the Pampa Melchorita meteorological station.
NM2	360092	8536401	NE to the Pampa Melchorita meteorological station, in the east border of the Panamerican Highway.
NM3	359905	8534879	SE of the Pampa Melchorita meteorological station.
NM4	361768	8532578	In the km 172 + 500m of the Panamerican Highway, near to the north boundary of "Nuevo Ayacucho" settlement.
NM5	362235	8530613	To the north boundary of Wakama resort.

Table 4-6. LEQ Values according to registered hours in Noise Measurement Sites.

Receptor	Hour	LEQ in DBA
NM1	Day/Night	40/30
NM2	Day/Night	64/62
NM3	Day/Night	43/29
Nuevo Ayacucho (NM4)	Day/Night	55/53
Wakama (NM5)	Day/Night	57/58

Table 4-7. Soil Sampling Site Coordinates

Site / Sampling Date	UTM Coordinates	
	North	East
S-01 (21-Jun-02)	8 535 500	359 500
C-2 (04-Ago-02)	8 535 485	359 523
S-02 (21-Jun-02)	8 535 215	359 200
C-3 (04-Ago-02)	8 535 234	359 181

Table 4-8. Parameters and Analytical Methods for Soil Sampling

Parameter	Method Detection Limit	Method
Arsenic	0.05 mg/kg	EPA 6010-B
Cadmium	0.15 mg/kg	EPA 6010-B
Copper	0.5 mg/kg	EPA 6010-B
Chromo	0.0 mg/kg	EPA 6010-B
Mercury	0.100 mg/kg	EPA 6010-B
Nickel	0.5 mg/kg	EPA 6010-B
TPH	8 mg/kg	EPA 8015-M
Lead	0.8 mg/kg	EPA 6010-B
Zinc	0.15 mg/kg	EPA 6010-B

Table 4-9. Soil Sampling Results

Parameter	Unit	Sites				Soil Remediation Criteria	
		S-01	S-02	C-2	C-3	CCME[1)]	LAWA[2)]
Arsenic	mg/kg	11.09	11.96	8.22	12.03	12	20 – 60
Cadmium	mg/kg	< 0.15	< 0.15	-	-	22	10 – 20
Copper	mg/kg	18.2	19.2	14.1	28.0	91	
Chromo	mg/kg	11.16	15.8	15.57	27.97	87	100 – 250
Mercury	mg/kg	< 0.10	< 0.10	-	-	50	2 – 5
Nickel	mg/kg	< 0.15	< 0.15	-	-	50	
TPH	mg/kg	< 8	< 8	-	-		1000 – 5000
Lead	mg/kg	12.08	15.90	6.3	7.1	600	80 – 200
Zinc	mg/kg	24.6	29.1	-	-	360	500 - 2000

1) Canadian Council of Ministries of the Environment for industrial use
2) LAWA: Länderarbeitsgemeinschaft Wasser (Germany).

Table 4-10. Coordinates and Depths for Marine Water Sampling Stations

Station	Sampling	UTM Coordinates		Sample Depth (m)		
		North	East	Surface (S)	Middle (M)	Bottom (P)
T2-10	Autumn 2002	358419.05274	8533755.99842	1.0	5.0	10.0
T2-12	Autumn 2002	358259.33919	8533596.64562	1.0	6.0	12.0
T2-16	Autumn 2002 – Spring 2002	357008.03290	8532348.16574	1.0	8.0	16.0
T3-0	Autumn 2002	358698.29765	8534739.28542	0.5		
T3-10	Autumn 2002	358163.30463	8534205.52743	1.0	5.0	10.0
T3-12	Autumn 2002 – Spring 2002	357934.60013	8533977.35089	1.0	6.0	12.0
T3-16	Autumn 2002	356376.55964	8532422.90712	1.0	8.0	16.0
T4-10	Autumn 2002 - - Spring 2002	357736.77350	8534478.10033	1.0	5.0	10.0
T4-12	Autumn 2002	357553.42520	8534295.16698	1.0	6.0	12.0
T4-16	Autumn 2002	356596.45881	8533340.36642	1.0	8.0	16.0
T5-10	Spring 2002	357529.92697	8534702.21996	1.0	5.0	10.0
T5-12	Spring 2002	357329.25559	8534502.00274	1.0	6.0	12.0
T5-16	Spring 2002	356371.26508	8533546.18038	1.0	8.0	16.0

Table 4-11. Parameters and Analytical Methods for Marine Water

Parameter	Analytical Method	Method Detection Limit
TSS	SM 2540-D	5 mg/l
TDS	EPA 160.1	10 mg/l
Bicarbonates	SM 4500CO2-D	0.1 mg/l
Chlorides	EPA 325.3	1 mg/l
Fluorides	EPA 340.2	0.01 mg/l
N-Nitrate	EPA 352.1	0.10 mg/l
Sulfates	EPA 375.4	0.5 mg/l
Total Cyanide	EPA 335.2	0.004 mg/l
Calcium	EPA 200.7	0.006 mg/l
Magnesium	EPA 200.7	0.002 mg/l
Sodium	EPA 200.7	0.04 mg/l
Potassium	EPA 200.7	0.20 mg/l
Iron	EPA 200.7	0.0004 mg/l
Selenium	EPA 200.7	0.0004 mg/l
Arsenic	EPA 200.7	0.002 mg/l
Barium	EPA 200.7	0.006 mg/l
Cadmium	EPA 200.7	0.006 mg/l
Chromium	EPA 200.7	0.004 mg/l
Copper	EPA 200.7	0.020 mg/l
Lead	EPA 200.7	0.03 mg/l
Nickel	EPA 200.7	0.01 mg/l
Strontium	EPA 200.7	0.0010 mg/l
Zinc	EPA 200.7	0.006 mg/l
Detergent	SM 5540-C	0.06 mg/l
Phenol	SM 5530-D	0.1 mg/l
Oil and greases	EPA 1664	5 mg/l
TPH (Total Petroleum Hydrocarbons)	EPA 8015M	0.2 mg/l

Table 4-12. Marine Water Analytical Results (Autumn 2002)

Parameter	Unit	Station											ECA LGA	BC Marine Water	EPA CCC*
		T2-10-S	T2-10-M	T2-10-P	T2-12-S	T2-12-M	T2-12-P	T2-16-S	T2-16-M	T2-16-P	T3-10-S	T3-10-M	Use VI		
Physical-Chemical Parameters															
PH		7.93	7.93	7.77	7.92	7.95	7.63	7.99	8.01	7.65	7.86	7.82			6.5-8.5
Conductivity	MS/cm	52.8	52.8	52.7	52.9	53.0	53.0	52.8	52.9	52.7	52.7	52.7			
TSS	mg/L	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5			
TDS	mg/L	35652	34992	35300	37116	36600	37588	32840	35412	36316	35084	35432			
Main and Concern Ions															
Bicarbonates	mg/L	120.4	118.3	120.5	118.7	120.5	118.7	116.4	118.3	119.1	120.1	118.2			
Chlorides	mg/L	19494	19594	19494	19594	19494	19494	19394	18894	19994	19194	19394			
Fluorides	mg/L	0.94	0.93	0.93	0.92	0.94	0.94	0.96	0.94	0.91	0.95	0.94			
N-Nitrates	mg/L	0.24	0.25	0.49	0.21	0.17	0.23	0.24	0.18	0.25	0.23	0.27	N.A.		
Sulfates	mg/L	2649	2442	2461	2320	2274	2431	2797	2668	2672	2165	2636			
Total cyanide	mg/L	<0,004	<0,004	<0,004	<0,004	<0,004	N,R,	<0,004	<0,004	<0,004	<0,004	<0,004	0,005	0,005	0,001
Total Metals															
Ca	mg/L	458,3	524,6	456,5	470,2	494,3	474,0	183,1	199,2	460,6	181,1	177,0			
Mg	mg/L	1312	1499	1341	1315	1335	1382	1266	1423	1305	1350	1276			
Na	mg/L	10860	12360	11050	10870	11280	1140	10270	11550	10710	11290	10610			
K	mg/L	472.5	538.1	459.8	479.2	482.6	484.1	447.3	497.4	468.3	490.2	449.8			
Hg	mg/L	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	0.0002		0.00094
Se	mg/L	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	0.010		0.071
As	mg/L	<0.002	<0.002	<0.002	<0.002	<0.0002	0.002	<0.002	<0.002	0.002	<0.002	<0.002	0.050	0.0125	0.036
Ba	mg/L	0.007	0.007	0.008	0.006	0.006	0.007	0.008	0.007	0.006	0.006	0.005			
Cd	mg/L	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	0.004	0.00012	0.0093
Cr	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.050		
Cu	mg/L	0.038	<0.020	<0.020	<0.020	<0.020	<0.020	0.027	<0.020	<0.020	<0.020	<0.020			0.0031
Pb	mg/L	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.030		0.0081
Ni	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			0.0082
Sr	mg/L	8.037	<8.916	8.147	7.926	8.010	8.580	3.871	4.255	7.840	3.951	3.765			
Zn	mg/L	0,034	0,024	0,020	0,022	0,024	0,024	0,032	0,029	0,021	0,030	0,031			0,081
Organic Parameters															
Detergents	mg/L	<0,06	<0,06	<0,06	<0,06	<0,06	<0,06	<0,06	<0,06	<0,06	<0,06	<0,06			
Phenols	mg/L	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	0,100		
Oils and greases	mg/L	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5			
TPH	mg/L	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2			

*N.R.: Not registered <: means less than the detection limit * CCC: Criterion Continuous Concentration Observations: Samples arrived well-preserved to the Lab.*

Table 4-12. Marine Water Analytical Results (Continued)

Parameter	Unit	Station											ECA LGA	BC Marine Water	EPA CCC*
		T3-12-S	T3-12-M	T3-12-P	T3-16-S	T3-16-M	T3-16-P	T4-10-S	T4-10-M	T4-12-S	T4-12-M	T4-12-P	Uso VI		
Physical-Chemical Parameters															
PH		7.88	7.93	7.65	7.70	7.68	7.74	7.76	7.77	7.90	7.79	7.64			6.5-8.5
Conductivity	MS/cm	52.7	52.9	52.6	53.0	53.0	52.8	52.8	52.9	52.9	52.6	52.9			
TSS	mg/L	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5			
TDS	mg/L	35112	33388	33444	35904	35456	37036	34712	34480	35552	35376	34528			
Main and Concern Ions															
Bicarbonates	mg/L	119.9	120.3	118.6	122.1	120.2	124.7	118.3	122.0	120.4	118.0	120.5			
Chlorides	mg/L	19394	19394	19294	19394	19694	19594	19294	19394	19394	19094	19194			
Fluorides	mg/L	0.96	0.95	0.96	0.95	0.94	0.93	0.95	0.94	0.95	0.94	0.94			
N-Nitrates	mg/L	0.27	0.48	0.22	0.33	0.34	0.37	0.23	0.39	0.27	0.32	0.40	N.A.		
Sulphates	mg/L	2452	2431	2564	2336	2432	2447	2594	2568	2474	2570	2576			
Total cyanide	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.005	0.005	0.001
Total Metals															
Ca	mg/L	464.0	198.6	196.8	481.0	454.4	438.7	180.3	185.4	493.6	468.3	187.5			
Mg	mg/L	1310	1381	1448	1382	1312	1272	1378	1349	1387	1349	1404			
Na	mg/L	10880	11370	11950	11480	10780	10540	11530	11130	11530	11150	11660			
K	mg/L	472.6	495.8	497.5	469.7	467.3	449.7	489.2	480.6	494.8	481.5	498.9			
Hg	mg/L	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	0.0002		0.00094
Se	mg/L	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	0.010		0.071
As	mg/L	<0.002	0.002	<0.002	<0.002	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.004	0.050	0.0125	0.036
Ba	mg/L	0.011	0.006	0.006	0.006	0.007	0.009	0.007	0.008	0.006	0.007	0.009			
Cd	mg/L	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	0.004	0.00012	0.0093
Cr	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.050		
Cu	mg/L	<0.020	<0.020	<0.020	<0.020	0.039	<0.020	<0.020	<0.020	<0.020	0.024	0.028			0.0031
Pb	mg/L	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.030		0.0081
Ni	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			0.0082
Sr	mg/L	6.185	4.373	4.205	8.450	7.479	6.882	4.008	3.886	5.643	5.186	3.840			
Zn	mg/L	0.051	0.034	0.054	0.026	0.103	0.030	0.038	0.054	0.023	0.033	0.034			0.081
Organic Parameters															
Detergents	mg/L	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06			
Phenols	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.100		
Oils and grease	mg/L	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5			
TPH	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2			

Table 4-12. Marine Water Analytical Results (Continued)

Parameter	Unit	Station			ECA LGA Use VI	BC Marine Water	EPA CCC*	Average	Std. Deviation	MAX
		T4-16-S	T4-16-M	T4-16-P						
Physical-Chemical Parameters										
PH		7.80	7.55	7.62			6.5-8.5			
Conductivity	MS/cm	52.7	52.8	52.9						
TSS	mg/L	<5	<5	<5				< 5	0	< 5
TDS	mg/L	34616	36204	34288				35159	1154	37588
Main and Concern Ions										
Bicarbonates	mg/L	120.0	120.3	120.7				120	2	125
Chlorides	mg/L	19494	19294	19394				19401	205	19994
Fluorides	mg/L	0.94	0.96	0.95				1	0	1
N-Nitrates	mg/L	0.41	0.41	0.25	N.A.			0	0	0
Sulfates	mg/L	2615	2654	2638				2515	143	2797
Total cyanide	mg/L	<0.004	<0.004	<0.004	0.005	0.005	0.001	0	0	0
Total Metals										
Ca	mg/L	180.3	190.2	195.1				335.8	146.8	524.6
Mg	mg/L	1282	1366	1454				1352	61	1499
Na	mg/L	10920	11390	12050				11185	502	12360
K	mg/L	474.1	497.5	525.1				479.9	22.9	538.1
Hg	mg/L	<0.0004	<0.0004	<0.0004	0.0002		0.00094	0.0004	0.0	0.0
Se	mg/L	<0.0004	<0.0004	<0.0004	0.010		0.071	0.0004	0.0	0.0
As	mg/L	<0.002	<0.002	<0.002	0.050	0.0125	0.036	0.0	0.0	0.0
Ba	mg/L	0.007	0.006	0.007				0.0	0.0	0.0
Cd	mg/L	<0.006	<0.006	<0.006	0.004	0.00012	0.0093	0.0	0.0	0.0
Cr	mg/L	<0.004	<0.004	<0.004	0.050			0.0	0.0	0.0
Cu	mg/L	<0.020	<0.020	<0.020			0.0031	0.022	0.005	0.039
Pb	mg/L	<0.03	<0.03	<0.03	0.030		0.0081	0.0	0.0	0.0
Ni	mg/L	<0.01	<0.01	<0.01			0.0082	0.0	0.0	0.0
Sr	mg/L	3.873	4.175	4.290				5.8	2.0	8.9
Zn	mg/L	0.051	0.040	0.037			0.081	0.0	0.0	0.1
Organic Parameters										
Detergents	mg/L	<0.06	<0.06	<0.06				<0.06	0	0
Phenols	mg/L	<0.1	<0.1	<0.1	0.100			0	0	0
Oils and grease	mg/L	<5	<5	<5				0	0	0
TPH	mg/L	<0.2	<0.2	N.R.				0	0	0

N.R.: Not registered <: means less than the detection limit * CCC: Criterion Continuous Concentration Observations: Samples arrived well-preserved to the Lab.

Table 4-13. Marine Water Analytical Results (Spring 2002)

Parameter	Unit	Station											ECA LGA	BC Marine Water	EPA CCC*
		T2-16-S	T2-16-M	T2-16-P	T3-12-S	T3-12-M	T3-12-P	T4-10-S	T4-10-M	T4-10-P	T5-10-S	T5-10-M	Use VI		
Physical-Chemical Parameters															
PH		8.38	8.27	8.35	8.29	8.25	8.12	8.29	8.17	7.92	8.38	8.11			6.5-8.5
Conductivity	MS/cm	52.81	53.15	53.12	53.60	53.03	53.20	53.76	53.92	53.82	53.10	53.90			
TDS	mg/L	37 200	38 800	38 620	39 126	38 226	38 876	39 600	40 050	39 550	38 776	39700			
Main and Concern Ions															
Bicarbonates	mg/L	125.9	118.9	129.2	113.2	119.1	125.9	120.0	125.9	126.1	126.7	125.9			
Chlorides	mg/L	19,653	19,954	19,703	19,954	19,853	19,653	19,753	19,954	19,753	19,653	19,452			
Fluorides	mg/L	0.46	0.45	0.44	0.47	0.46	0.47	0.47	0.46	0.46	0.47	0.47			
N-Nitrates	mg/L	0.12	0.12	< 0.10	< 0.10	0.21	0.11	0.18	0.55	0.22	0.22	0.32	N.A.		
Total Metals															
Ca	mg/L	460.4	439.9	468.6	429.1	446.9	446.4	441.6	456.9	406.7	406.5	411.7			
Mg	mg/L	1513	1469	1459	1405	1475	1483	1431	1481	1353	1336	1379			
Na	mg/L	9397	9557	9296	9104	9573	9208	9374	9407	9250	9404	9599			
K	mg/L	480.6	47,.0	454.9	465.2	490.1	474.0	479.4	485.3	453.1	440.9	454.7			
Hg	mg/L	<0.004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	0.0002		0.00094
Se	mg/L												0.010		0.071
As	mg/L												0.050	0.0125	0.036
Ba	mg/L	0.009	0.007	0.008	0.006	0.009	0.009	0.008	0.006	0.010	0.009	0.008			
Cd	mg/L	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	0.004	0.00012	0.0093
Cr	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.050		
Cu	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020			0.0031
Pb	mg/L	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.030		0.0081
Ni	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			0.0082
Sr	mg/L	9.315	9.805	10.93	8.738	9.221	8.917	9.014	9.097	8.535	7.888	8.008			
Zn	Mg/L	0.025	0.015	0.042	0.025	0.023	0.029	0.023	0.020	0.018	0.048	0.040			0.081
Organic Parameters															
TPH	Mg/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2			

N.R.: Not registered <: means less than the detection limit * CCC: Criterion Continuous Concentration Observations: Samples arrived well-preserved to the Lab.

Table 4-13. Marine Water Analytical Results (continued)

Parameter	Unit	Station							ECA LGA Use VI	BC Marine Water	EPA CCC*	Average	Std. Deviation.	MAX
		T5-10-P	T5-12-S	T5-12-M	T5-12-P	T5-16-S	T5-16-M	T5-16-P						
Physical-Chemical Parameters														
PH		7.97	8.08	8.21	7.81	8.10	7.76	7.96			6.5-8.5			
Conductivity	MS/cm	53.84	53.78	52.80	53.95	53.54	53.80	53.75						
TDS	mg/L	39550	39850	38650	40600	39500	40350	39850				39321	795	40050
Main and Concern Ions														
Bicarbonates	mg/L	126.0	125.6	119.2	126.2	125.6	125.6	119.5				123.6	4.1	129.2
Chlorides	mg/L	19552	19552	19552	19703	19753	19552	19653				19 703	143	19 954
Fluorides	mg/L	0.47	0.47	0.46	0.46	0.49	0.47	0.46				0.47	0.01	0.47
N-Nitrates	mg/L	0.46	<0.10	0.11	0.14	0.12	0.13	0.25	N.A.			0.20	0.1	0.21
Total Metals														
Ca	mg/L	389.4	372.4	424.1	447.0	386.7	387.0	391.9				420.4	29.2	468.6
Mg	mg/L	1329	1264	1399	1471	1303	1294	1325				1381	98	1513
Na	mg/L	9417	8854	9897	10460	8863	9095	9299				9368	373	9599
K	mg/L	444.4	419.6	464.7	494.6	422.6	429.6	436.3				457.9	22.2	490.1
Hg	mg/L	<0.0004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.0002		0.00094	-	-	-
Ba	mg/L	0.008	0.008	0.009	0.008	0.015	0.008	0.008				0.008	0.002	0.010
Cd	mg/L	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	0.004	0.00012	0.0093	-	-	-
Cr	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.050			-	-	-
Cu	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020			0.0031	-	-	-
Pb	mg/L	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	0.030		0.0081	-	-	-
Ni	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			0.0082	-	-	-
Sr	mg/L	7.805	7.371	8.249	8.699	7.443	7.639	7.690				8.495	0.910	10.93
Zn	mg/L	0.083	0.028	0.032	0.031	0.018	0.061	0.015			0.081	0.031	0.017	0.083
Organic Parameters														
TPH	mg/L	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2				-	-	-

N.R.: Not registered <: means less than the detection limit * CCC: Criterion Continuous Concentration Observations: Samples arrived well-preserved to the Lab.

Table 4-14. Marine Sediment Stations Coordinates

Station	Sampling	UTM Coordinates		Depth
		East	North	m
T2-10	Autumn 2002	358419.05274	8533755.99842	10
T2-12	Autumn 2002	358259.33919	8533596.64562	12
T2-16	Autumn 2002 – Spring, 2002	357008.03290	8532348.16574	16
T3-0	Autumn 2002	358698.29765	8534739.28542	-
T3-10	Autumn 2002	358163.30463	8534205.52743	10
T3-12	Autumn 2002 – Spring, 2002	357934.60013	8533977.35089	12
T3-16	Autumn 2002	356376.55964	8532422.90712	16
T4-10	Autumn 2002 - Spring, 2002	357736.77350	8534478.10033	10
T4-12	Autumn 2002	357553.42520	8534295.16698	12
T4-16	Autumn 2002	356596.45881	8533340.36642	16
T5-10	Spring 2002	357529.92697	8534702.21996	10
T5-12	Spring 2002	357329.25559	8534502.00274	12
T5-16	Spring 2002	356371.26508	8533546.18038	16

Table 4-15. Parameters and Analytical Methods for Marine Sediments

Parameter	Analytical Methods	Method Detection Limit
Arsenic	EPA 6010-B	0.05 mg/kg
Cadmium	EPA 6010-B	0.15 mg/kg
Copper	EPA 6010-B	0.5 mg/kg
Chromium	EPA 6010-B	0.10 mg/kg
Mercury	EPA 6010-B	0.10 mg/kg
Nickel	EPA 6010-B	0.5 mg/kg
TPH	EPA 8015-M	8 mg/kg
Lead	EPA 6010-B	0.8 mg/kg
Zinc	EPA 6010-B	0.15 mg/kg

Table 4-16. Marine Sediment Results (Autumn 2002)

Parameter	Unit	Station											ECA CCME (1)	Average	Std. Deviation
		T2-10	T2-12	T2-16	T3-0	T3-10	T3-12	T3-16	T4-10	T4-12	T4-16	T4-10D*			
Arsenic	mg/kg	5.36	10.73	7.94	1.94	3.72	9.80	13.64	3.18	6.41	9.68	4.69	12	7.01	3.65
Cadmium	mg/kg	< 0.15	< 0.15	2.08	< 0.15	< 0.15	< 0.15	2.49	< 0.15	< 0.15	2.93	< 0.15	22	2.49 (max)	-
Copper	mg/kg	19.3	16.9	8.0	14.6	18.6	15.7	9.3	13.5	18.2	9.9	18.8	91	14.62	4.48
Chromium	mg/kg	11.33	19.88	11.21	4.47	9.64	20.07	15.07	10.63	11.04	13.39	6.98	87	12.16	4.79
Mercury	mg/kg	< 0.10	< 0.10	< 0.10	< 0.10	0.21	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.26	50	0.26 (max)	-
Nickel	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	50	< 0.5	-
TPH	mg/kg	< 8	< 8	< 8	< 8	< 8	< 8	< 8	< 8	< 8	< 8	< 8		< 8	-
Lead	mg/kg	53.8	85.5	41.1	29.3	50.5	51.2	61.9	46.3	53.4	53.5	43.2	600	51.79	14.05
Zinc	mg/kg	45.81	47.83	23.02	44.37	45.79	44.34	28.23	41.85	45.92	26.68	47.26	360	40.10	9.28

(1) Canadian Environmental Quality Guidelines, Canadian Council of Ministers of the Environment, 1999

*Duplicate sample

Table 4-17. Marine Sediment Results (Spring 2002)

Parameter	Unit	Station							CCME [1]	Average	Std. Deviation
		T2-16	T3-12	T4-10	T5-10	T5-12	T5-16	T5-16 D*			
Arsenic	mg/kg	10.29	11.9	9.35	9.41	8.14	7.3	7.16	12	9.08	1.70
Cadmium	mg/kg	2.53	2.42	1.1	1.95	2.17	2.43	2.20	22	2.23	0.24
Copper	mg/kg	9.7	11.4	12.5	9.9	19.0	9.2	8.7	91	11.49	3.56
Chromium	mg/kg	6.93	7.41	6.21	6.68	5.53	6.32	6.0	87	6.44	0.62
Mercury	mg/kg	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	50	-	-
Nickel	mg/kg	3.0	3.4	3.2	3.0	3.5	2.6	2.6	50	3.17	0.59
TPH	mg/kg	< 8	< 8	< 8	< 8	< 8	< 8	< 8		-	-
Lead	mg/kg	9.2	10.8	9.8	8.8	8.6	8.5	9.2	600	9.27	0.81
Zinc	mg/kg	23.07	29.75	29.75	36.45	29.23	40.06	25.01	360	29.60	6.53

(2) Canadian Environmental Quality Guidelines, Canadian Council of Ministers of the Environment, 1999

*Duplicate sample

Figure 4-1: Pampa Melchorita Noise Monitoring at Site 1 -24 hours 15 min SPL

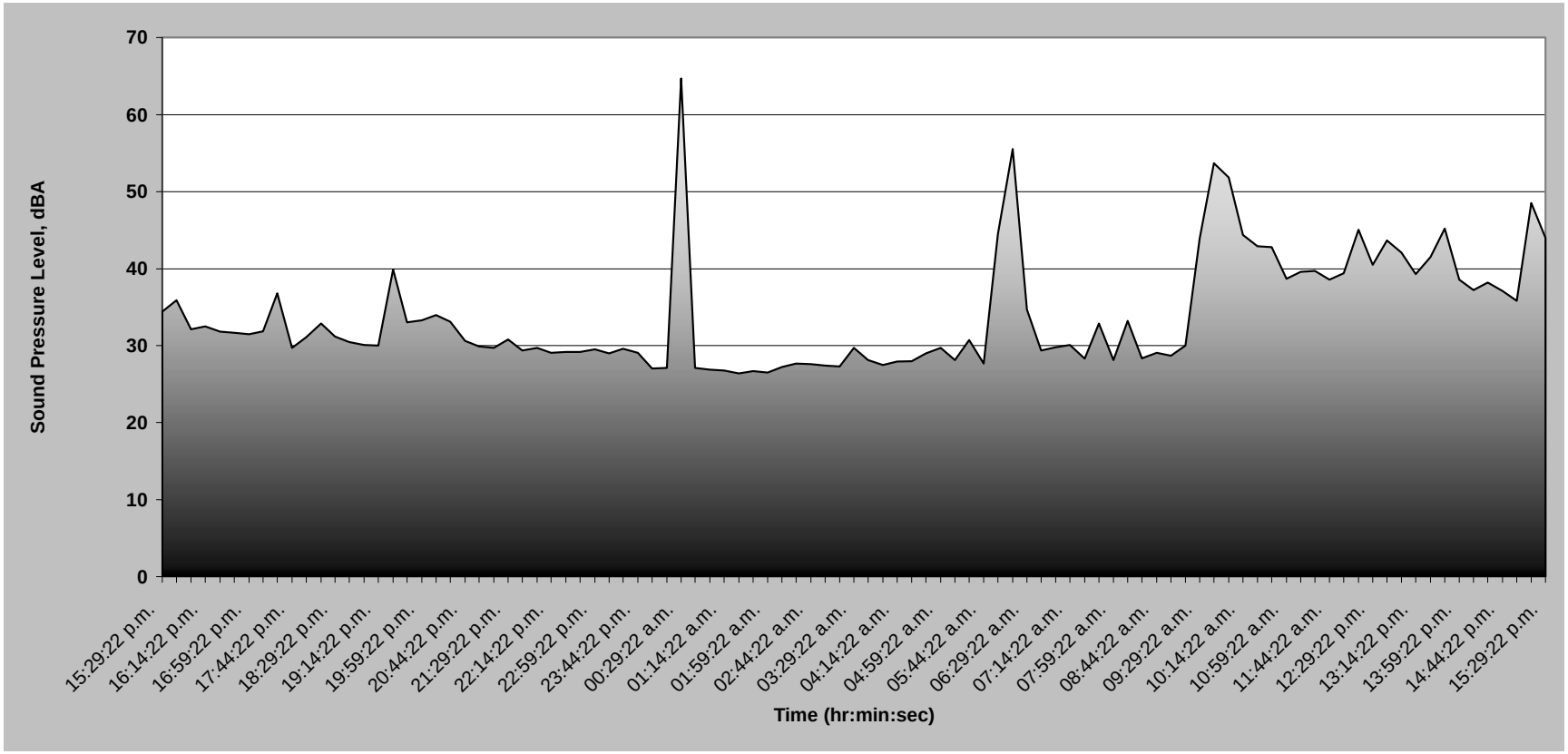


Figure 4-2: Pampa Melchorita Noise Monitoring at Site 2 -24 hours 15 min SPL

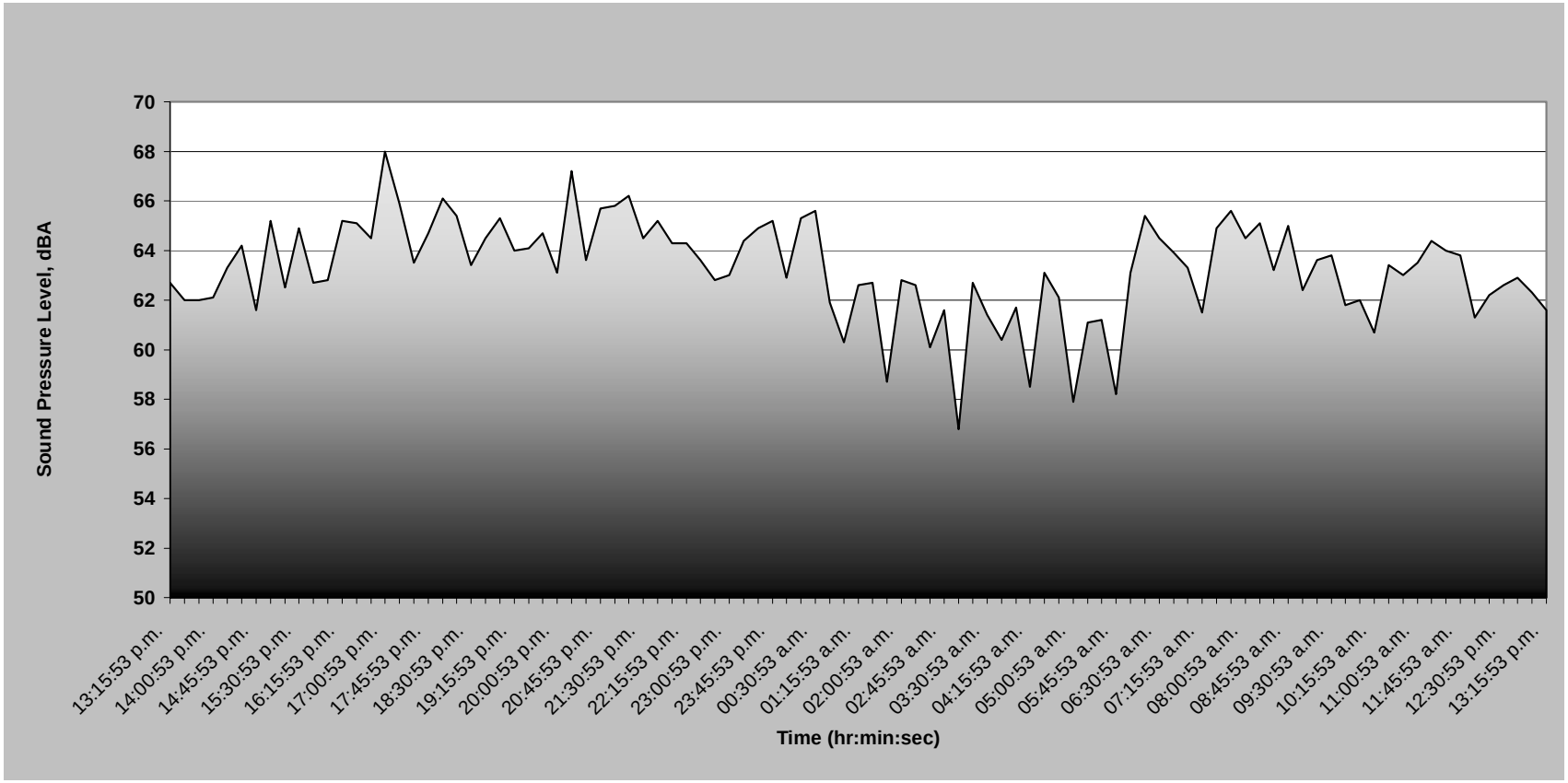


Figure 4-3: Pampa Melchorita Noise Monitoring at Site 3 -24 hours 15 min SPL

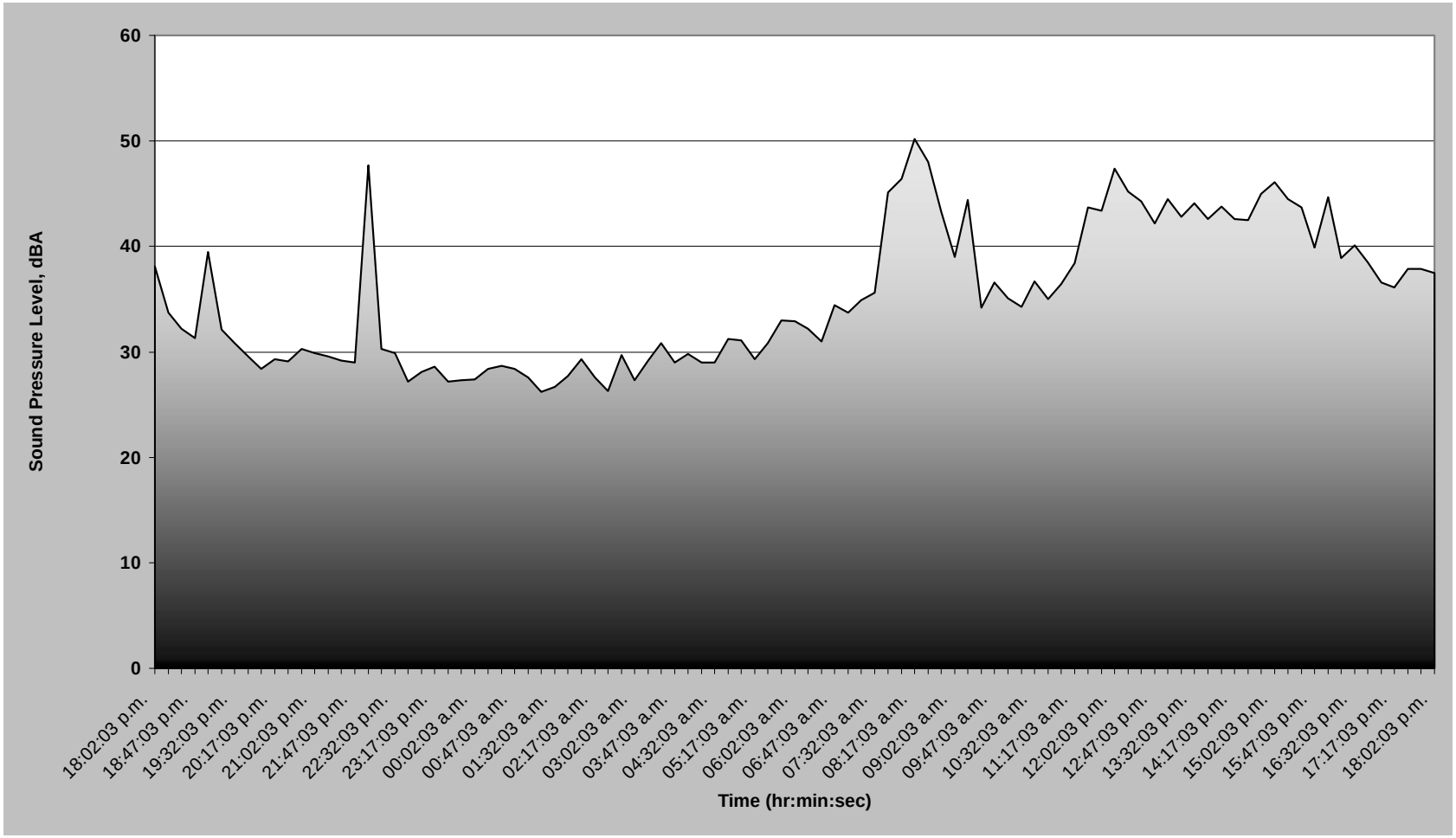


Figure 4-4: Pampa Melchorita Noise Monitoring at Site 4 -24 hours 15 min SPL

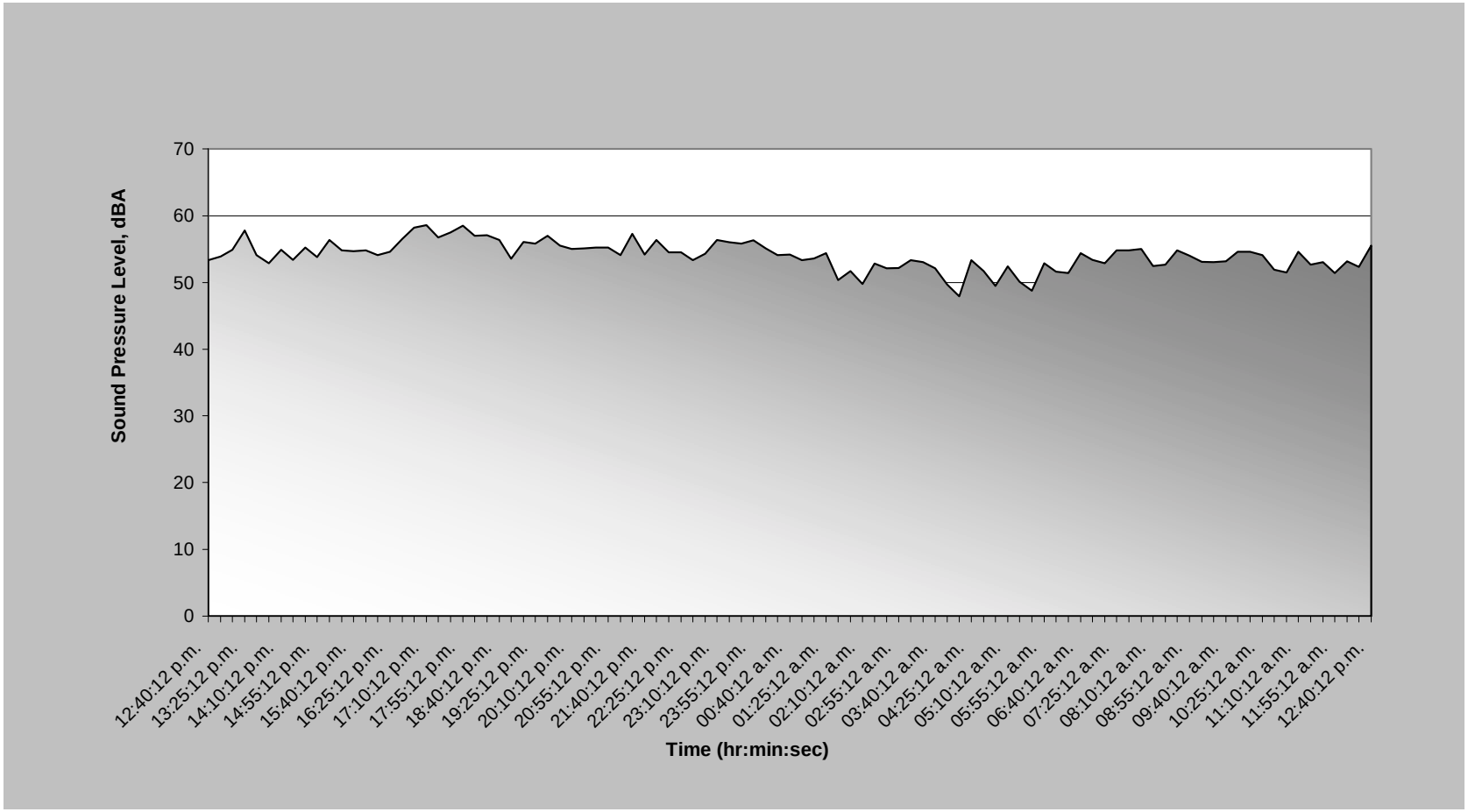


Figure 4-5: Pampa Melchorita Noise Monitoring at Site 5 -24 hours 15 min SPL

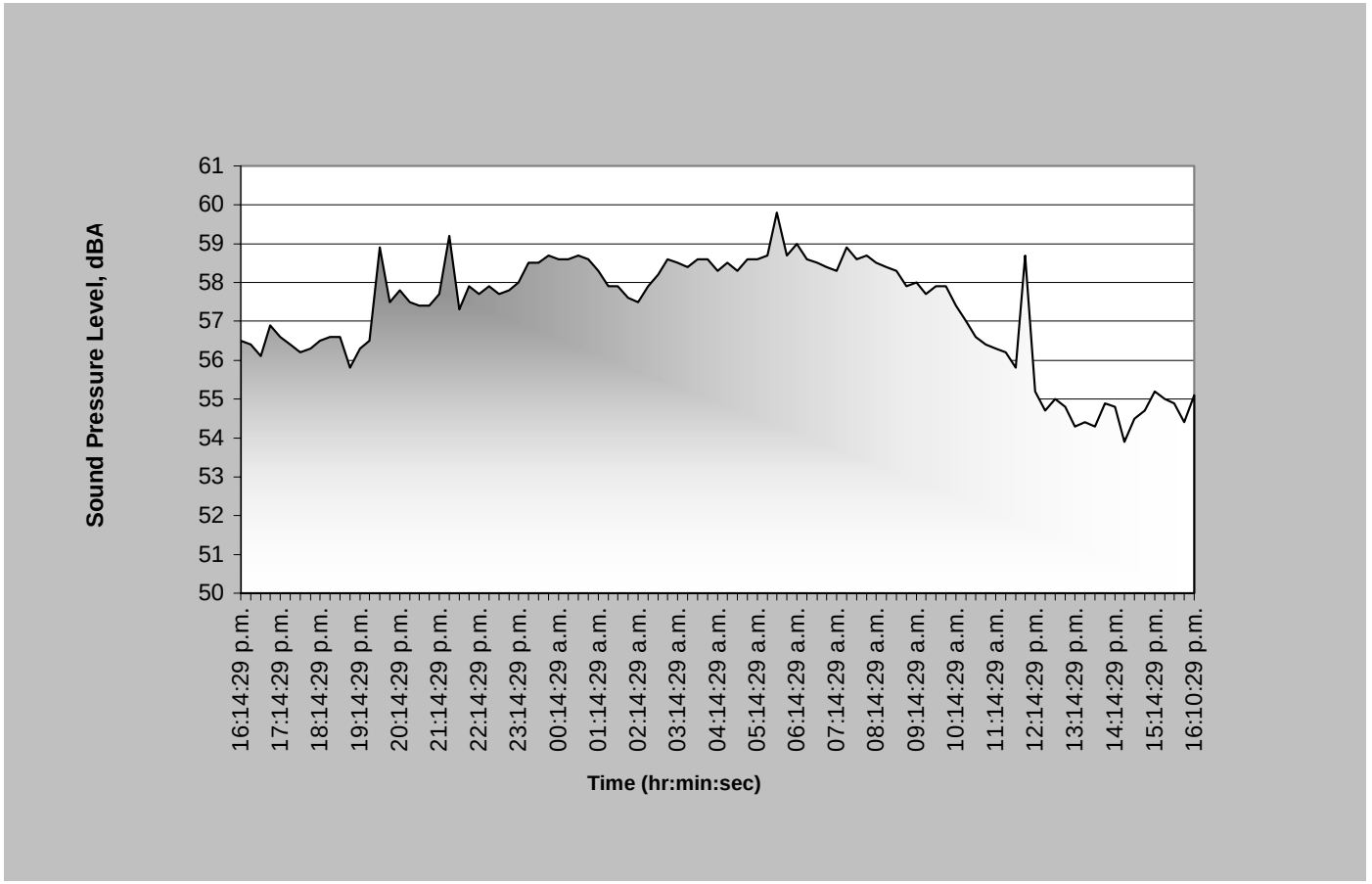
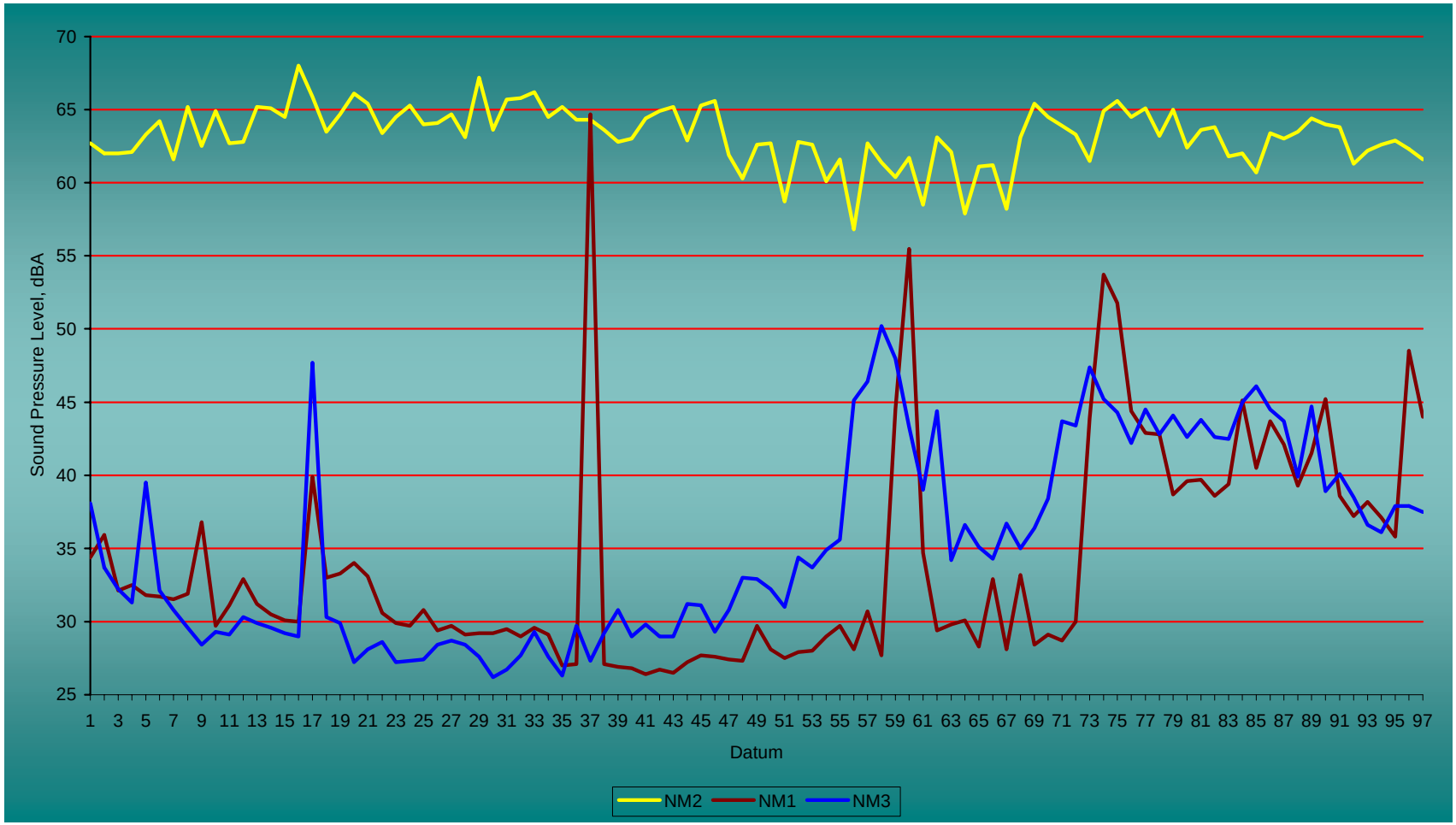
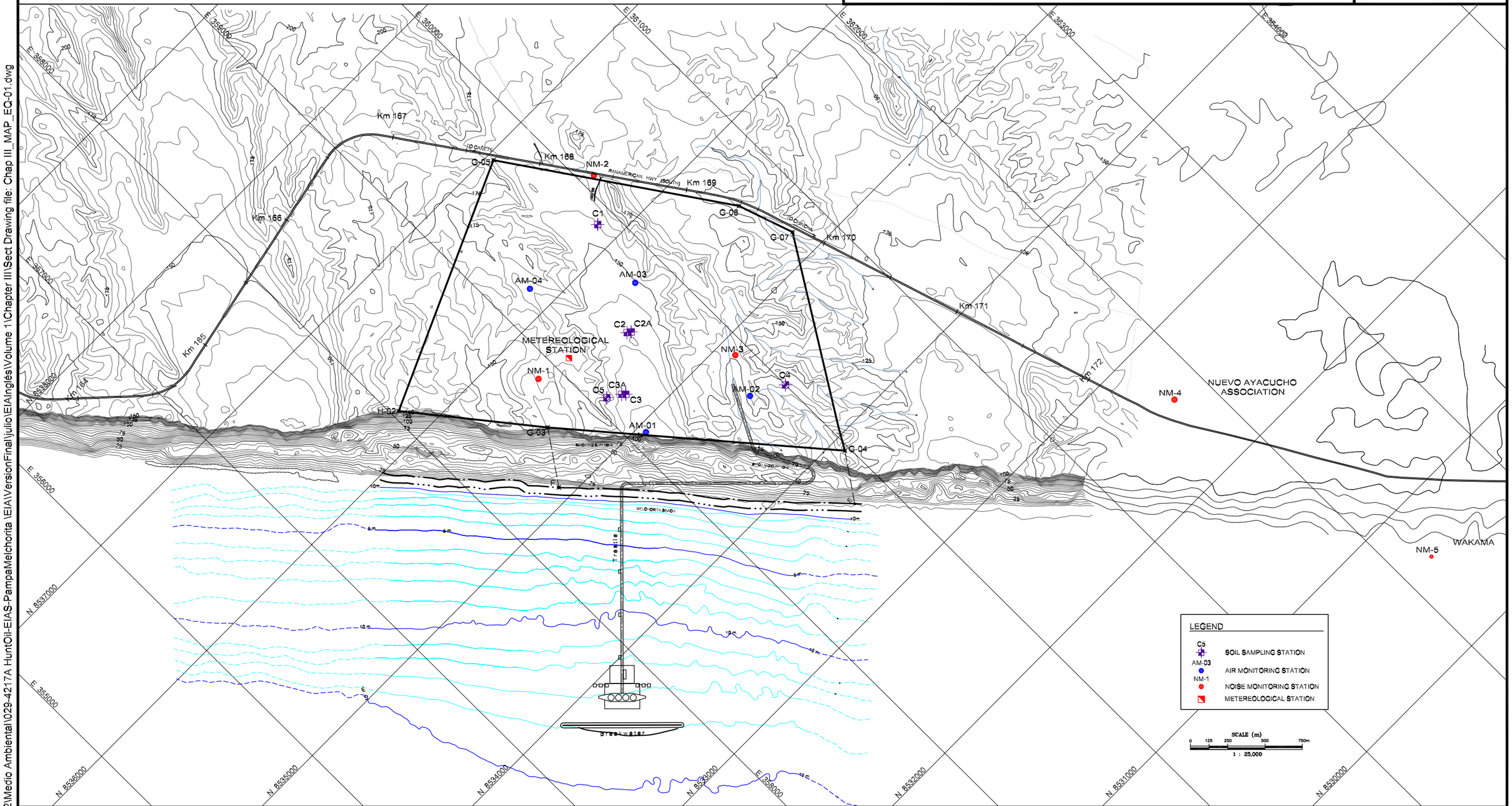


Figure 4-6: Pampa Melchorita Comparative Noise Monitoring at Sites 1, 2, 3 – 24 hours 15 min SPL



PERU LNG S.R.L.
LNG EXPORT PROJECT
TERRESTRIAL SAMPLING SITES
(AIR, NOISE AND SOIL STATIONS)

MAP EQ - 01



Date JULY 2003

Project 029-4217

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Aug 01, 2003 - 7:50pm
Por: William Ynga
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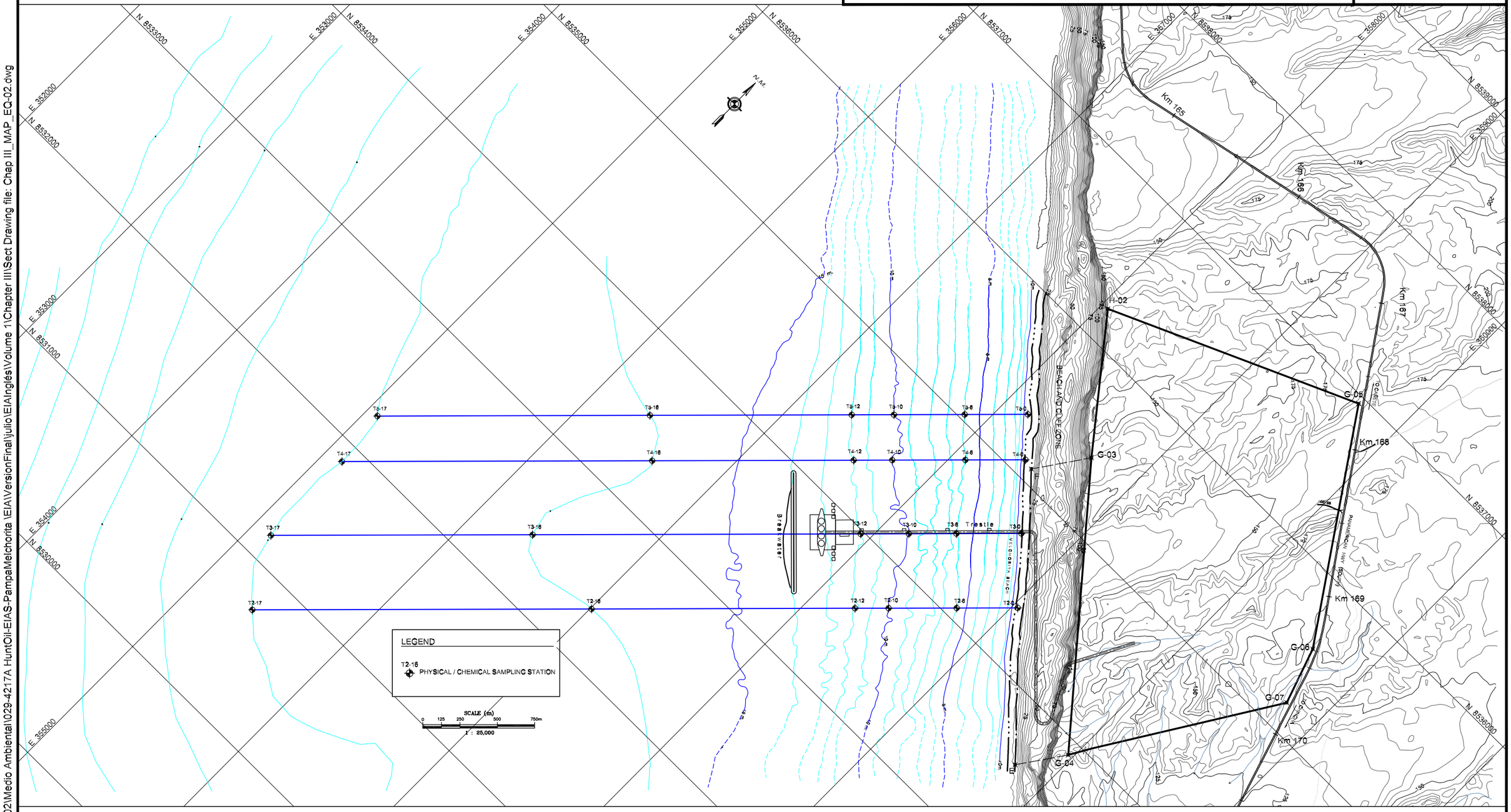
PERU LNG S.R.L.
LNG EXPORT PROJECT
MARINE SAMPLING STATIONS
(WATER and SEDIMENTS)

MAP EQ - 02



Date JULY 2003

Project 029-4217

Golder Associates

Drawn N.K.

Rev. R.L.

Aug 01, 2003 - 7:54pm
Por: William Ynga
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