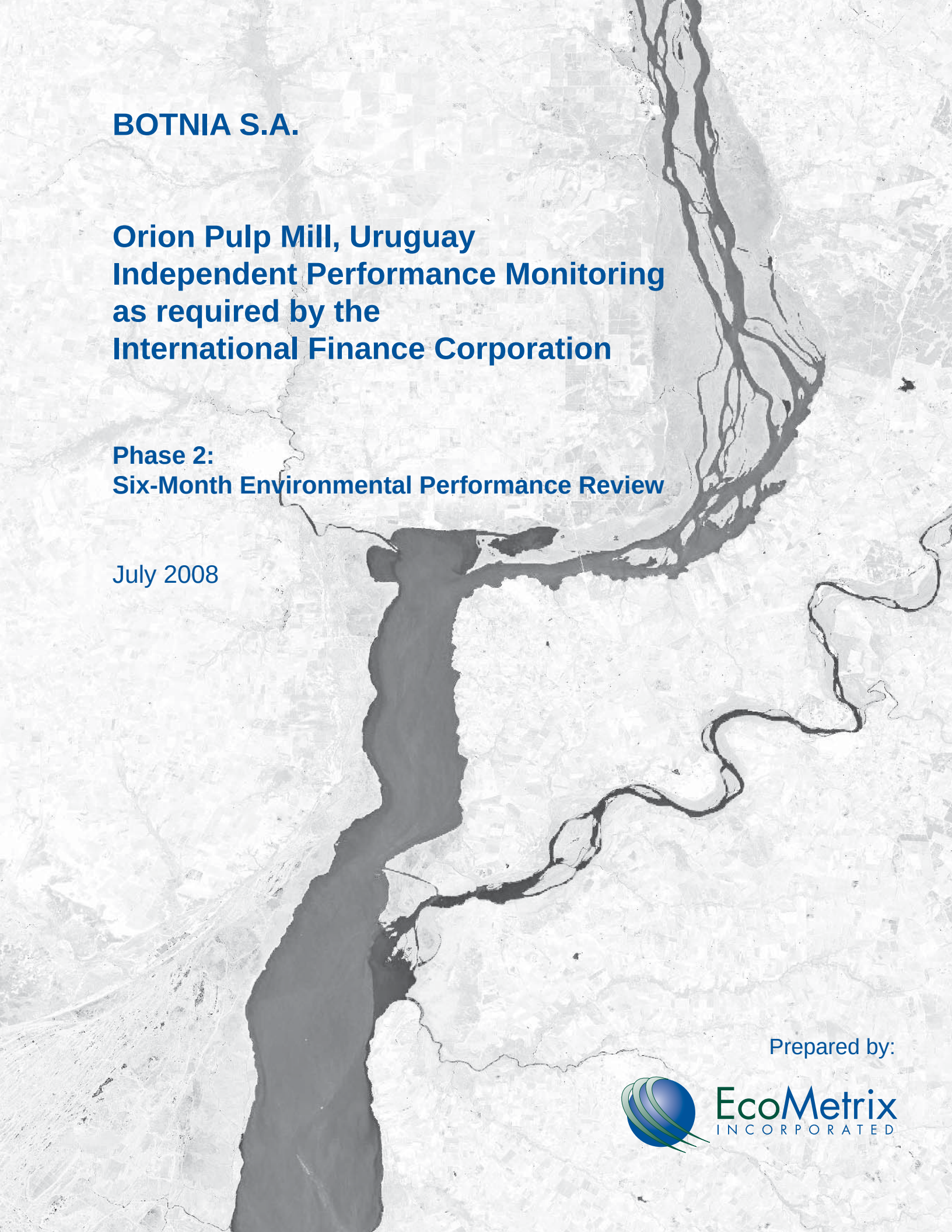
BOTNIA S.A.

Orion Pulp Mill, Uruguay
Independent Performance Monitoring as required by the International Finance Corporation

Phase 2:
Six-Month Environmental Performance Review

July 2008



Prepared by:

EcoMetrix INCORPORATED

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Phase 2: Six-Month
Environmental Performance Review

FINAL

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July 2008

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EXECUTIVE SUMMARY

Overview

Botnia S.A. (Botnia) developed the Orion project alongside the Río Uruguay approximately 5 km upstream (east) of the city of Fray Bentos in Uruguay. The project consists of a bleached Kraft pulp mill (the mill) designed to produce approximately 1,000,000 air dried tonnes of pulp on an annual basis (ADt/a). The mill was granted authorization to start production on 8 November 2007 from the Ministry of Housing, Territorial Planning and Environment (Ministerio de Vivienda, Ordenamiento Territorial y Medio Ambiente, MVOTMA). Actual production began on 10 November 2007.

Botnia has prepared and publicly disclosed an environmental and social impact assessment (EIA) for the Orion project that describes the expected impacts of the project and the mitigation and enhancement measures to manage those impacts. The potential environmental and social impacts for the Orion project were also independently assessed and verified through a Cumulative Impact Study (CIS) commissioned by the International Finance Corporation (IFC). The CIS was completed in September 2006 by EcoMetrix Incorporated (EcoMetrix) and its consultants, SENES Consultants Limited (SENES) and Processys Incorporated (Processys).

To ensure that the key recommendations of the CIS were appropriately implemented and IFC environmental requirements complied with, Botnia and IFC prepared and agreed on an Environmental and Social Action Plan (ESAP) for the Orion project. This plan identified 16 actions which were achieved by Botnia prior to the commissioning of the mill. For many of these actions, the minimum requirements specified in the ESAP were exceeded. In a few cases, additional actions were identified to ensure the intended long term outcome of the ESAP.

Purpose of Report

This report is the second of four reports by EcoMetrix relating to the Independent Monitoring of Environmental and Social Performance of the mill as required by the ESAP. The first report was prepared prior to commissioning of the mill to confirm compliance with the requirements of the ESAP. This second report was prepared following the first six months of operation, and the subsequent reports will be prepared each year over the first two years of operation.

This second report has the following specific mandate:

1. to provide an independent review and analysis of the data on air and water emissions based on actual performance of the mill during this initial six month period;
2. to assess the actual environmental effects as compared to those predicted in the CIS.

Operationally, the first six months of any new pulp mill is referred to as the initial start-up phase, during which time production is periodically interrupted to facilitate process changes to improve operational efficiency and performance. This report provides an evaluation of the performance of the mill during this initial start-up phase.

Based on experience with other new modern pulp mills, these operational improvements continue through the first two years following start-up, during which time perfecting steps are taken to optimize performance. Subsequent reports will be prepared to further evaluate

the operational and environmental performance of the mill through these first two years of operation. These subsequent reports will also review environmental and social monitoring data to verify the intended outcomes of the ESAP.

This evaluation draws upon the monitoring data obtained by Botnia, the Dirección Nacional de Medio Ambiente (DINAMA), the Obras Sanitarias del Estado (OSE), the Laboratorio Tecnológico del Uruguay (LATU), and other independent laboratories. Baseline monitoring was undertaken prior to mill start-up by the Comisión Administradora del Río Uruguay (CARU) and is used in this report for water quality comparison purposes. The available monitoring data provide a direct measure of the emissions from the mill and the associated effects, if any, on the ambient environment during the initial start-up period.

Performance is measured through comparisons to specific benchmarks. For emissions, these benchmarks include the permit limits specified in the operating license, and the expected performance as predicted in the CIS and based on best available technologies (BAT) and experience with similar modern pulp mills. For this six-month review, the performance measures account for the short-term variability expected during this initial start-up phase as process changes are implemented and operational efficiencies improve. For this reason, it is premature to consider long-term average performance projections.

From this review and to this point in time, all indications are that the mill is performing to the high environmental standards predicted in the EIA and CIS, and in compliance with Uruguayan and IFC standards. These results are also consistent with the performance measures for other modern mills. The bases of these conclusions are provided in the following sections.

Mill Production

The mill started production on 10 November 2007. Over the first six-months of operation, the mill produced approximately 405,000 ADt of pulp, as compared to the reference annual production of 1,000,000 ADt.

Effluent Discharge Characteristics

The Orion mill discharges the treated final effluent to the Río Uruguay through a submerged, multi-port diffuser. The operating license for the mill requires that Botnia monitor the rate and quality of this discharge. These data are reviewed in Section 3.0 for the purpose of quantifying the actual rate and quality of the final effluent as compared to the limits specified by DINAMA and to the expected loadings predicted in the CIS. The main findings from this review are summarized in the following points:

- The mill started production on 10 November 2007 and has since then discharged treated effluent to the Río Uruguay. The average discharge rate over the first six-months of operation was 0.86 m^3/s in comparison to an expected discharge rate of 0.83 m^3/s predicted in the CIS.
- The mill has complied with the maximum concentration limits specified by DINAMA for 5-day biochemical oxygen demand (BOD_5), total phosphorus, total nitrogen, adsorbable organic halogens (AOX), pH, ammonia, nitrate, fecal coliform, sulphide, oil and grease, mercury, arsenic, cadmium, copper, chromium, nickel, lead, zinc and dioxin and furan. The only exception was a two-hour exceedance of total suspended

solids (TSS) on one occasion. Corrective actions were taken and a contingency report was prepared and filed with DINAMA.

- The mill has complied with the allowable monthly maximum load limit as specified by DINAMA for all regulated parameters, which are chemical oxygen demand (COD), BOD_5, TSS, total phosphorus, total nitrogen and AOX.
- On a production basis, the monthly maximum load for COD, TSS, ammonia, total nitrogen and total phosphorus was below the expected load as predicted in the CIS. The monthly load for BOD_5 was consistently below the expected load following the first month of operation and after the required period to initialize the biological treatment system. The expected monthly maximum load for color was exceeded during this six-month period, although the load is comparable to other modern mills.

Water Quality of the Río Uruguay

Water quality of the Río Uruguay was monitored by DINAMA at 17 stations along the river. During the first six-months of operation, three surveys were conducted, two during moderate flows within the Río Uruguay and one during relatively low flows. Water quality was also monitored by the OSE, who are responsible for the treatment and distribution of potable water to the community of Fray Bentos. These data are evaluated in Section 4.0 to determine the potential effect of the effluent discharge on the water quality of the Río Uruguay. Data are compared to surface water quality criteria, baseline water quality, and between upstream and downstream monitoring stations in order to classify the water quality and quantify any potential temporal or spatial change. These data are also compared to predictions from the CIS to verify its conclusions. The main findings are summarized in the following points:

- The water of the Río Uruguay is considered to be of high quality since the concentrations of most indicator parameters are well below the most restrictive of the applicable Uruguayan and CARU standards. These parameters include: pH, dissolved oxygen, BOD_5, nitrate, turbidity, fluoride, chloride, sulfate, R.A.S., cyanide, arsenic, boron, copper, chromium, mercury, nickel, zinc, and total phenols. As noted in the CIS, exceptions include bacteria, total phosphorus and iron, which exceeded the most restrictive standard prior to commissioning of the mill due to natural and anthropogenic sources throughout the watershed.
- A comparison of the monitoring data pre- and post-commissioning of the mill shows that the water quality of the Río Uruguay has not changed as a result of the mill. Only conductivity and AOX show a small increase in the immediate vicinity of the diffuser, which indicates the presence of mill effluent at a dilution in the range 125:1 to 170:1.
- The water quality between the mill and Fray Bentos is comparable to the water quality further upstream beyond the influence of the mill, indicating that the mill has not affected water quality within the Río Uruguay.
- The CIS concluded that the water quality within the Río Uruguay would remain in compliance with surface water quality standards of DINAMA and CARU (with the noted exception of total phosphorus due to its high baseline concentration resulting from natural and anthropogenic sources throughout the watershed); and that trace

levels of wastewater from the mill would not adversely affect water quality. The water quality monitoring results from DINAMA confirm these conclusions.

Air Emissions

The air emissions for the Orion mill are routinely monitored as required by DINAMA. These data are reviewed in Section 5.0 to compare the actual air emissions to limits specified by DINAMA and to the expected loadings predicted in the CIS. The main findings from this review are summarized in the following points:

- The air emissions from the mill have remained well within the allowable limits specified in the permit issued by DINAMA. The concentrations of total particulate material (TPM), sulphur dioxide (SO_2), nitrogen oxide (NO_x) and total reduced sulphur (TRS) have remained below the respective threshold values within the required 90% frequency.
- The air emissions are well below the expected loads predicted in the CIS for TPM and carbon monoxide (CO), and, other than the first month of operation, for TRS and SO_2. The load for NO_x is comparable to, but has exceeded, the expected maximum value predicted in the CIS. Optimization of the recovery boiler and lime kiln for NO_x often takes one or two years following commissioning based on the experience with other similar modern mills. Air emissions are expected to improve as the production of the mill increases to full capacity and as further optimization measures are implemented during the start-up phase. These anticipated improvements will be reviewed in the one- and two-year monitoring reports.
- The emissions of TRS are generally below the expected emissions predicted in the CIS. The mill has had some releases of malodorous gases. These releases were predicted in the CIS and reported to the community as possibilities prior to the commissioning of the mill.

Ambient Air Quality

Air quality is measured at a monitoring station located between Fray Bentos and the mill. The available data are evaluated in Section 6.0 to assess the potential effect of the mill operations on the ambient air quality. The main conclusions from this review are summarized in the following points:

- The air near the City of Fray Bentos is considered to be of high quality since the concentrations of the indicator parameters CO, NO_x, SO_2, inhalable particulate material (PM_{10}) and total suspended particulate (TSP) are well below the ambient air quality objectives specified by DINAMA in the Autorización Ambiental Previa (AAP).
- The air quality objective for TRS was exceeded on three occasions in April 2008 at this monitoring station, although these events are not attributed to the mill since the emissions from the mill were low at the time and well within the CIS projected range for normal operations. It is possible that these exceedances can be attributed to the widespread fires that were burning within the delta of the Río Parana of Argentina during this same period. Satellite images show that the smoke from these fires extended over large areas of Argentina and Uruguay, including the Fray Bentos vicinity (see earth.esa.int/ew/fires/argentina_fires_apr08/fi_argentina-apr07.htm).

- Objectionable odors were detected by residents of Fray Bentos on 21 November 2007 and on 27 November 2007 during the first month of operation. There have been no complaints of odor from the community since. A newspaper article indicated odors were present in the City of Gualeguaychú, Argentina, during the event on 27 November 2007.
- Mild odors were detected by mill personnel on four occasions between the mill and Fray Bentos. These reported events coincided with recorded short-duration releases of malodorous gases from the mill. Odors were detected on eight other occasions; however, these events do not coincide with recorded releases of malodorous gases from the mill, and on two of these occasions were reported from upwind locations.
- The slight variations in air quality near Fray Bentos between the periods pre- and post-start-up are within the range of natural variability.
- The observations during the first six-months of operation are consistent with the conclusions of the CIS. The ambient air quality has remained well within the levels predicted in the CIS and objectives of the operating permit for the mill, and therefore it can be stated that there are no risks to human health. Objectionable odors were reported on two occasions and mild odors were reported on at least four other occasions over the first six months of operation. In comparison, the CIS predicted 10 odor events during the first year of operation.

1.0 INTRODUCTION

1.1 Overview

Botnia S.A. (Botnia) developed the Orion project alongside the Río Uruguay approximately 5 km upstream (east) of the city of Fray Bentos in Uruguay. The project consists of a bleached Kraft pulp mill (the mill) designed to produce approximately 1,000,000 air dried tonnes of pulp on an annual basis (ADt/a). The wood is sourced from established eucalyptus plantations within western and central-north Uruguay. The mill was granted authorization to start production on 8 November 2007 from the Ministry of Housing, Territorial Planning and Environment (Ministerio de Vivienda, Ordenamiento Territorial y Medio Ambiente, MVOTMA). Actual production began on 10 November 2007.

Botnia has prepared and publicly disclosed an environmental and social impact assessment (EIA) for the Orion project that describes the expected impacts of the project and the mitigation and enhancement measures to manage those impacts. The potential environmental and social impacts for the Orion project were also independently assessed and verified through a Cumulative Impact Study (CIS) commissioned by the International Finance Corporation (IFC). The CIS was completed in September 2006 by EcoMetrix Incorporated (EcoMetrix) and its consultants, SENES Consultants Limited (SENES) and Processys Incorporated (Processys).

It is important to note by way of context that the CIS assessed the combined environmental and social impacts for the Orion project and a second proposed pulp mill nearby to have been built by ENCE (since relocated). Therefore, the study can be considered to have overstated the potential impacts given that the Orion mill is now the only one operating in the area of Fray Bentos.

To ensure that the key recommendations of the CIS were appropriately implemented and IFC environmental requirements complied with, Botnia and IFC prepared and agreed on an Environmental and Social Action Plan (ESAP) for the Orion project. A copy of the ESAP is available at the respective websites of Botnia and the IFC:

www.metsabotnia.com/es/default.asp?path=284,1530,1329,1056

www.ifc.org/ifcext/lac.nsf/Content/Uruguay_PulpMills_Background_Docs

The ESAP identifies 16 specific actions relating to the following: 1. ISO certification; 2. hazardous materials; 3. emergency preparedness and response; 4. transportation; 5. community development; 6. conservation; 7. solid waste; 8. groundwater monitoring; 9. independent verification of process and preparedness; 10. independent monitoring of environmental and social performance; 11. plantations; 12. public grievance; 13. public disclosure; 14. municipal water supply; 15. municipal wastewater; and 16. chemical recovery of black liquor from Pamer Papelera Mercedes S.A.

Prior to the commissioning of the mill, EcoMetrix undertook an independent review to confirm compliance with the commitments detailed in the ESAP. It concluded that the requirements identified in the ESAP had been achieved, and, for many of the identified actions, the minimum requirements had been exceeded. In a few cases, additional actions had been identified to ensure the intended long term outcome of the ESAP. The final report,

issued in November 2007, is also available through the respective websites of Botnia and the IFC as listed above.

1.2 Purpose of Report

This report addresses a component of Action No. 10, Independent Monitoring of Environmental and Social Performance. It is the second of four reports that will be issued over a two year period following the commissioning of the mill. The first report, referenced above, was prepared prior to commissioning of the mill to confirm compliance with the requirements of the ESAP. This second report was prepared following the first six months of operation with the following specific mandate:

1. to provide an independent review and analysis of the data on air and water emissions based on actual performance of the mill during this initial six month period;
2. to assess the actual environmental effects as compared to those predicted in the CIS.

Subsequent reports will be prepared to review the environmental and social monitoring data through each of the first two years of operation and will include a comprehensive review of ESAP compliance.

1.3 Methodology

Operationally, the first six months of any new pulp mill is referred to as the initial start-up phase, during which time production is periodically interrupted to facilitate process changes to improve operational efficiency and performance. Based on experience with other new modern mills, these improvements continue through the first two years following a pulp mill's start-up, during which time perfecting steps are taken to optimize performance.

During this initial start-up phase, comprehensive monitoring of air and water emissions was undertaken by Botnia, as outlined in Table 1.1. These data provide a detailed characterization of the quantity and quality of the air and water emissions, and a direct measure of the operational efficiency and performance of the mill to this point in time. This information is used by Botnia to identify areas for further improvement and optimization. It is also used by the Dirección Nacional de Medio Ambiente (DINAMA) to verify that the mill is operating according to the authorization limits specified in the environmental authorizations for the mill (Autorización Ambiental Previa, AAP; Autorización de Desagüe Industrial, ADI).

Monitoring has also been conducted by DINAMA, the Obras Sanitarias del Estado (OSE), the Laboratorio Tecnológico del Uruguay (LATU), and other independent laboratories to evaluate the potential effects of the mill operations on the ambient environment. Baseline monitoring was undertaken prior to mill start-up by the Comisión Administradora del Río Uruguay (CARU) and is used in this report for water quality comparison purposes. Comprehensive field surveys have been undertaken along the Río Uruguay to measure water quality, and an air monitoring station has been constructed near the City of Fray Bentos to measure ambient air quality. These data provide a basis to confirm that the authorization limits for air and water emissions from the mill are protective of human health and the environment, and provide a basis to confirm that the various predictions of environmental effect are valid to this point in time.

These data for emissions and environmental monitoring are reviewed and analyzed herein to provide an independent evaluation of environmental performance and assessment of potential environmental effects during this initial start-up phase.

Other environmental monitoring data has and will continue to be undertaken by Botnia, DINAMA, OSE and LATU. These additional data will be evaluated in subsequent reports as the database develops.

Table 1.1: Summary of Emissions Monitoring Program

Media	Location	Parameter	Frequency
Effluent quality	• Outlet from the effluent treatment plant	• pH • COD • BOD_5 • SS • AOX • N • P • Conductivity • >40 additional parameters	• Daily • Daily • Daily • Daily • Weekly • Weekly • Weekly • Daily • Parameter specific
Air quality	• Stack recovery boiler • Lime furnace • Gas boiler GOL • Gas boiler GOS	• SO_2, TRS, NO_x, Dust, CO • SO_2, TRS, NO_x, Dust • SO_2, TRS • SO_2, TRS, NO_x	• Continuous • Continuous • Continuous • Continuous

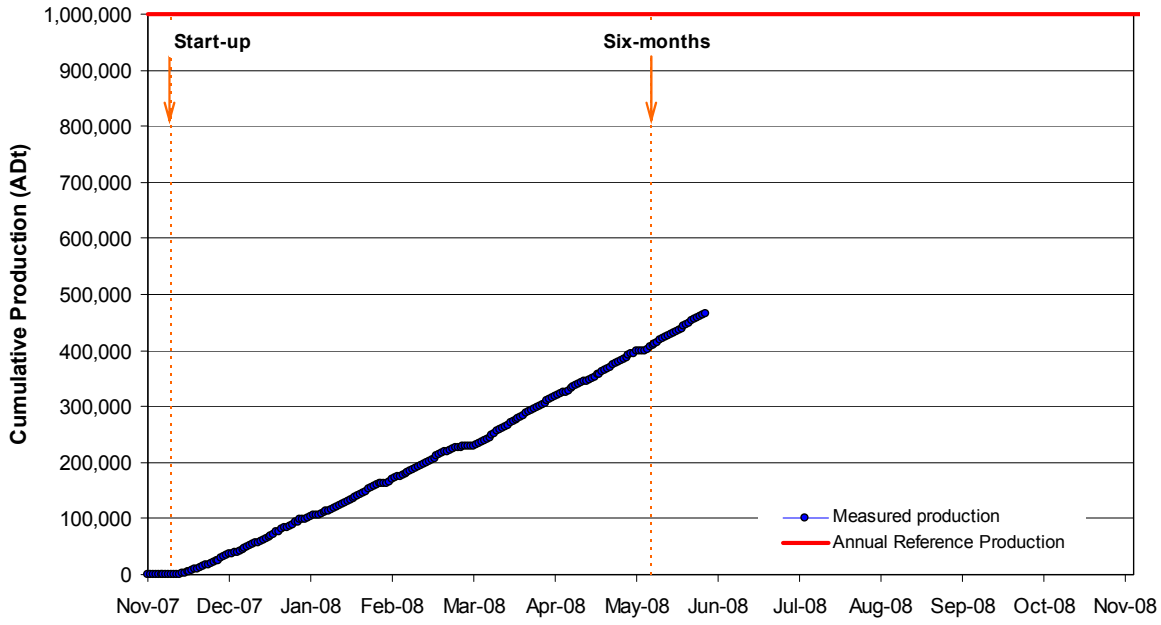
2.0 MILL PRODUCTION

The mill started production on 10 November 2007. Over the first six-months of operation, the mill produced approximately 405,000 ADt of pulp, as summarized in Table 2.1 and Figure 2.1. In comparison, the reference annual production for the mill is 1,000,000 ADt, and the reference daily production is 2,857 ADt/d based on 350 operating days per year.

Table 2.1: Mill Production during the First Six-Months of Operation

Month	Average Daily Production (ADt/d)
November 2007	1,030
December 2007	2,203
January 2008	2,072
February 2008	2,222
March 2008	2,541
April 2008	2,608

Figure 2.1: Cumulative Mill Production



3.0 EFFLUENT DISCHARGE CHARACTERISTICS

3.1 Overview

The Orion mill discharges the treated final effluent to the Río Uruguay through a submerged, multi-port diffuser. The operating license for the mill requires that Botnia monitor the rate and quality of this discharge. These data are reviewed in the following section to compare the actual loadings from the mill to limits specified by DINAMA in the ADI and to expected loadings predicted in the CIS. The main findings from this review are summarized in the following points:

- The mill started production on 10 November 2007 and has since then discharged treated effluent to the Río Uruguay. The average discharge rate over the first six-months of operation was 0.86 m^3/s in comparison to an expected discharge rate of 0.83 m^3/s predicted in the CIS.
- The mill has complied with the maximum concentration limits specified by DINAMA for 5-day biochemical oxygen demand (BOD_5), total phosphorus, total nitrogen, adsorbable organic halogens (AOX), pH, ammonia, nitrate, fecal coliform, sulphide, oil and grease, mercury, arsenic, cadmium, copper, chromium, nickel, lead, zinc and dioxin and furan. The only exception was a two-hour exceedance of total suspended solids (TSS) on one occasion. Corrective actions were taken and a contingency report was prepared and filed with DINAMA.
- The mill has complied with the allowable monthly maximum load limit as specified by DINAMA for all regulated parameters, which are chemical oxygen demand (COD), BOD_5, TSS, total phosphorus, total nitrogen and AOX.
- On a production basis, the monthly maximum load for COD, TSS, ammonia, total nitrogen and total phosphorus was below the expected load as predicted in the CIS. The monthly load for BOD_5 was consistently below the expected load following the first month of operation and after the required period to initialize the biological treatment system. The expected monthly maximum load for color was exceeded during this six-month period although it is not dissimilar to other modern mills.
- After six months of operation, all indications are that the mill is performing to the high environmental standards predicted in the EIA and CIS, and in compliance with Uruguayan and IFC standards. These results are also consistent with the performance measures for other modern mills.

3.2 Mill Effluent Discharge Rate

The effluent discharge rate from the mill to the Río Uruguay has been monitored on a continuous basis since start-up of the mill. The available data are presented in Figure 3.1. The average effluent discharge rate over the six-month period from 10 November 2007 to

10 May 2008 was 0.86 m^3/s. In comparison, the expected discharge rate predicted in the CIS was 0.83 m^3/s.

3.3 Mill Effluent Quality

The quality of the mill effluent is monitored on a routine basis as per the schedule presented in Table 1.1. Available data are presented in Figure 3.2 for conventional parameters associated with pulp mill effluents, and summarized in Table 3.1 and Table 3.2 for a more comprehensive list of parameters.

These data provide for a comprehensive evaluation of the liquid emissions from the mill for the first six months of operation. They are compared to the respective concentration limits in Figure 3.2 and to the allowable maximum monthly load in Figure 3.3. Both of these limits are specified in the ADI. These data are also compared to the expected monthly maximum load from the CIS in Figure 3.3, which is based on best available technologies and experience with similar modern pulp mills. Together, these comparisons provide for a realistic assessment of the operational performance of the mill during this period.

This report does not seek to compare the mill performance to the long term annual average loadings since they are based on the long term expected performance of the mill following the start-up phase. It is not reasonable to compare these values after the first six-months of operations or even after the first year since, during this time, perfecting steps are ongoing to optimize performance.

The effluent quality is discussed in the following sections.

3.3.1 Conventional Parameters

The temperature of the mill effluent averaged 28ºC, and ranged from 22ºC to 31ºC based on a daily average. The temperature was 1ºC above the permit limit of 30ºC on 2 days during the six-month period. These occasions corresponded to periods of high water temperature within the Río Uruguay. The permit limit of 30ºC is based on end-of-pipe quality standards from Article 11 of Decree 253/79 rather than site-specific environmental considerations. The expected maximum temperature from the CIS of 30ºC was also based on Decree 253/79, however, as discussed in the CIS, the Río Uruguay has considerable capacity to assimilate the thermal load from the mill and any potential change in water temperature would be minimal, limited to the immediate vicinity of the diffuser and not adversely affect the environment.

The conductivity of the mill effluent averaged 2,644 µS/cm, and ranged from 180 µS/cm to 4,336 µS/cm. The operating licence for the mill does not specify a permit limit for conductivity as it is generally not considered a parameter of environmental concern at the levels typically reported by pulp mills. The expected maximum monthly conductivity from the CIS was 5,000 µS/cm, which is greater than the observed value.

The pH of the mill effluent ranged from 6.9 to 7.9, which is within the typical range for the ambient waters of the Río Uruguay and within the permit limits of 6.0 to 9.0. The expected pH from the CIS was also within the range of 6.0 to 9.0.

The colour of the mill effluent averaged 650 u.c., and ranged from 300 u.c. to 1,750 u.c.. The permit does not specify a limit for color. The maximum monthly load of color was 30

kg/ADt which is higher than the expected monthly maximum load of 10 kg/ADt predicted in the CIS. The expected change in color within the Río Uruguay as predicted in the CIS will change proportionally, although the potential change remains small and within the natural variability of the river.

The TSS of the mill effluent averaged 24 mg/L, and ranged from 4 mg/L to 264 mg/L. The maximum TSS exceeded the daily maximum permit limit of 150 mg/L for a period of less than two-hours on one occasion (18 April 2008) due to an interruption in operations. As required by Botnia's operational guidelines, corrective actions were taken and a contingency report was prepared and filed with DINAMA. The maximum monthly load of TSS during this six-month period was 2.4 t/d, in comparison to a permit limit of 3.7 t/d. On a production basis the load was 0.92 kg/ADt which is below the expected load of 1.3 kg/ADt predicted in the CIS.

3.3.2 Oxygen Demand

Oxygen demand is characterized by COD and BOD_5. Both are used as indicators of the operating performance of the wastewater treatment system, whereas BOD_5 is also used as a basis to assess the environmental effect on dissolved oxygen levels within the receiving environment. These monitoring data demonstrate a higher degree of treatment performance than expected in the CIS.

The COD of the mill effluent averaged 224 mg/L, and ranged from 90 mg/L to 490 mg/L. The maximum monthly load was 21.4 t/d, which is well below the permit limit of 56 t/d. On a production basis, the maximum monthly load was 9.6 kg/ADt, in comparison to an expected load of 15 kg/ADt as predicted in the CIS.

The BOD_5 of the mill effluent averaged 12 mg/L, and reached a maximum of 44 mg/L. These values are well below the daily maximum permit limit of 60 mg/L. The BOD_5 concentration was greatest during the first month of operation during the required period to initialize the biological treatment system. The temporal variability reflects the improved efficiency of the wastewater treatment system as operations progressed from this initial start-up phase. The monthly load of BOD_5 follows the same temporal trend with a maximum load of 1.2 t/d during the initial month of operation, and a load in the range of 0.5 t/d to 0.9 t/d thereafter. These loads are well below the permit limit of 2.6 t/d. On a production basis, the maximum monthly load was 1.1 kg/ADt during the initial month of operation, and ranged from 0.3 kg/ADt to 0.4 kg/ADt thereafter following initialization of the biological treatment system. Loadings post-start-up are well below the expected monthly maximum load of 0.7 kg/ADt predicted in the CIS. These low loadings of BOD_5 will have negligible effect on the dissolved oxygen levels within the Río Uruguay.

3.3.3 Nutrients

Nutrients are characterized by total nitrogen and total phosphorus. Elevated levels of nutrients promote the growth of algae and aquatic vegetation. Generally the rate of growth is limited by one or the other of these nutrients, but not both. Where the level of total nitrogen is the limiting nutrient for growth, the growth of algae is insensitive to small changes in the level of total phosphorus.

Total nitrogen is a measure of all organic and inorganic forms of nitrogen (TKN, nitrite and nitrate). The total nitrogen of the mill effluent averaged 3.4 mg/L, and ranged from 1.3 mg/L to 7.6 mg/L, in comparison to the permit limit of 8 mg/L. The maximum monthly load was 0.3 t/d, well below the permit limit of 0.74 t/d. On a production basis, the maximum monthly load was 0.22 kg/ADt during the initial month of operation, and reduced to the range of 0.06 to 0.14 kg/ADt thereafter. In comparison, the expected maximum monthly load predicted in the CIS was 0.26 kg/ADt.

Total phosphorus of the mill effluent averaged 0.58 mg/L, and ranged from 0.28 mg/L to 1.34 mg/L in comparison to a permit limit of 5 mg/L. The maximum monthly load was 0.046 t/d, well below the permit limit of 0.074 t/d, and, on a production basis was 0.026 kg/ADt in comparison to an expected load of 0.03 kg/ADt as predicted in the CIS. The CIS further indicated that the anticipated treatment of Fray Bentos' municipal wastewater would substantially offset these loadings.

3.3.4 Metals

Metals are generally not of concern in modern pulp mills. In some cases trace levels of metals may be associated with the wood supply and/or process chemicals. Metals routinely monitored by the mill include: arsenic, cadmium, copper, chrome, iron, mercury, nickel, lead and zinc. The concentrations of these metals in the final effluent are below the respective detection limits and well below the respective permit limits.

3.3.5 Resin Acids and AOX

Resin acids are generally not a concern for modern pulp mills due to improvements in process and treatment technologies. Resin acids are also less of a concern with eucalyptus than with softwood fiber sources. This is certainly the case for the Orion mill. Resin acids are consistently not detectable in the mill effluent at the 0.02 mg/L level.

The AOX of the mill effluent averaged 1.08 mg/L, and ranged from 0.02 mg/L to 1.72 mg/L, well below the permit limit for AOX of 6 mg/L. The monthly maximum load of AOX was 0.13 t/d, well below the permit limit of 0.56 t/d, and on a production basis the load was 0.05 kg/ADt well below the expected value predicted the CIS of 0.15 kg/ADt.

3.3.6 Dioxins and Furans

Dioxins and furans are generally not associated with modern pulp mills. As reported in the CIS, experience at other modern ECF mills throughout the world has shown that the most toxic congeners of dioxins and furans are not produced in the bleaching process at detectable levels, and that the less toxic congeners, although potentially detectable, are generally not elevated above ambient levels.

This statement that dioxins and furans are not associated with modern mills is also true for the Orion mill. The most toxic congeners 2,3,7,8-TCDD and 2,3,7,8-TCDF were non-detectable at the 1 pg/L (as TEQ) level based on three separate analyses.

3.3.7 Toxicity

Toxicity analysis shows no lethal response as summarized in Table 3.2. Monthly testing has been completed following standard protocols using three separate test procedures.

Table 3.1: Summary of Effluent Quality during the First Six-Months of Operation

Parameters	Units	Effluent Quality (10 November 2007 to 10 May 2008)					Permit Limit Daily Max
		n	Minimum	Maximum	Average	95th Percentile	
Physical Indicators							
Temperature	°C	183	22.3	30.9	28.4	30.1	30
pH	-	183	6.9	7.9	7.4	7.6	6.0 to 9.0
Conductivity	µS/cm	183	180	4,336	2,644	3,669	-
Color	n.c.	181	300	1,750	650	1,400	-
Chemical oxygen demand	mg/L	181	90	490	224	354	-
Biochemical oxygen demand	mg/L	179	2.8	44.0	12.0	29.7	60
Suspended solids	mg/L	181	4	264	24	61	150
Nutrients							
Ammonia	mg/L	29	0.01	1.00	0.12	0.59	5
Nitrate	mg/L	28	0.01	4.60	1.15	3.55	4
Total nitgrogen	mg/L	26	1.32	7.57	3.42	6.91	8
Total phosphorus	mg/L	69	0.28	1.34	0.58	0.99	5
Metals							
Arsenic	mg/L	6	<0.01	<0.20	<0.14	-	0.5
Cadmium	mg/L	6	<0.01	<0.05	<0.04	-	0.05
Chrome	mg/L	6	<0.10	<0.20	<0.13	-	1
Copper	mg/L	6	<0.03	<0.50	<0.34	-	1
Iron	mg/L	6	<0.10	0.70	<0.40	-	-
Mercury	mg/L	6	<0.001	<0.005	<0.002	-	0.005
Sodium	mg/L	6	290	800	507	743	-
Nickel	mg/L	6	<0.05	<0.05	<0.05	-	2
Lead	mg/L	6	<0.01	<0.05	<0.04	-	0.3
Sulphur	mg/L	5	<0.10	<0.10	<0.10	-	1
Zinc	mg/L	6	<0.05	<0.30	<0.13	-	0.3
Other							
AOX	mg/L	20	0.02	1.72	1.08	1.69	6
Chlorophenols	µg/L	21	0.05	3.7	1.1	3.4	-
Phenols	µg/L	26	<1	91	19	45	500
Chlorate	mg/L	25	<0.10	109	18	86	-
Resin acids, total	mg/L	5	0.02	0.02	0.02	0.02	-
Detergents (LAS)	µg/L	5	14	31	18	15	-
Esteroles, total	µg/L	5	<1000	<1000	<1000	-	-
Fats	mg/L	5	<10	<10	<10	-	50
Cyanide	µg/L	6	<5	<5	<5	-	-
Fecal coliforms	ufc/100 ml	21	<18	4,900	292	230	5,000
2,3,7,8-TCDD	pg/L	3	<1	<1	<1	<1	15
2,3,7,8-TCDF (as TEQ)	pg/L	3	<1	<1	<1	<1	5

Table 3.2: Summary of Toxicity Analysis for the Mill Effluent

Date	IC50 15min - Vibrio fischeri %	CL50 48hs - Daphnia magna %	CL50 96hs - Pimephales promelas %
Dec-07	>100 (non-toxic)	>100 (non-toxic)	>100 (non-toxic)
Jan-08	>100 (non-toxic)	>100 (non-toxic)	>100 (non-toxic)
Feb-08	>100 (non-toxic)	>100 (non-toxic)	>100 (non-toxic)
Mar-08	>100 (non-toxic)	>100 (non-toxic)	>100 (non-toxic)
Apr-08	>100 (non-toxic)	>100 (non-toxic)	>100 (non-toxic)
May-08	>100 (non-toxic)	>100 (non-toxic)	>100 (non-toxic)

Figure 3.1: Effluent Monitoring Data – Discharge Rate

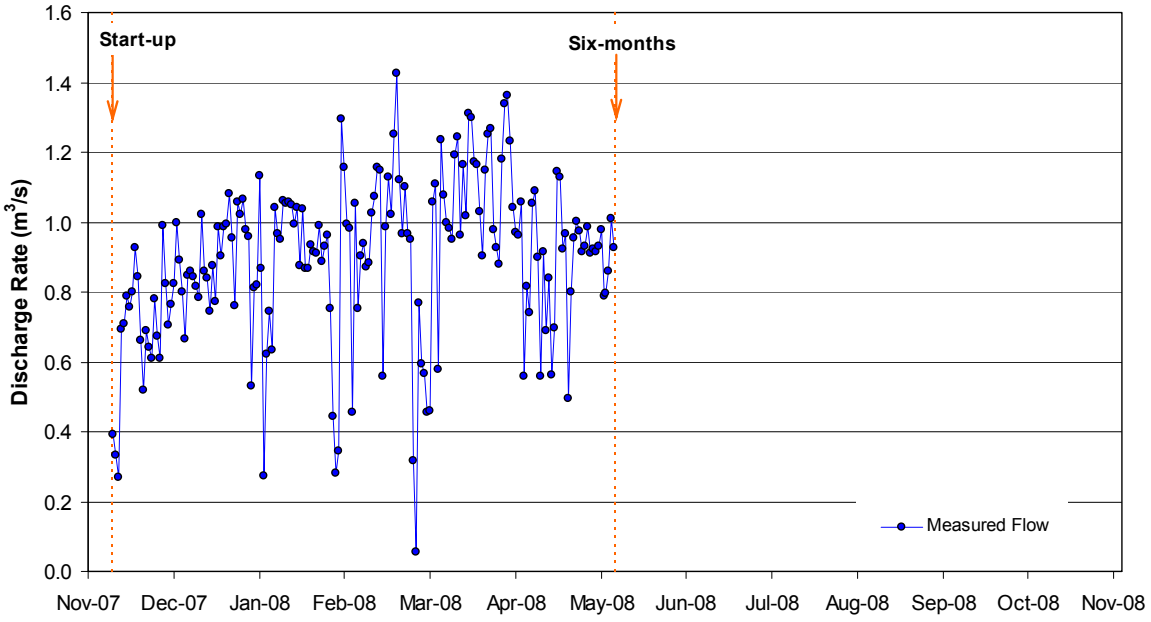
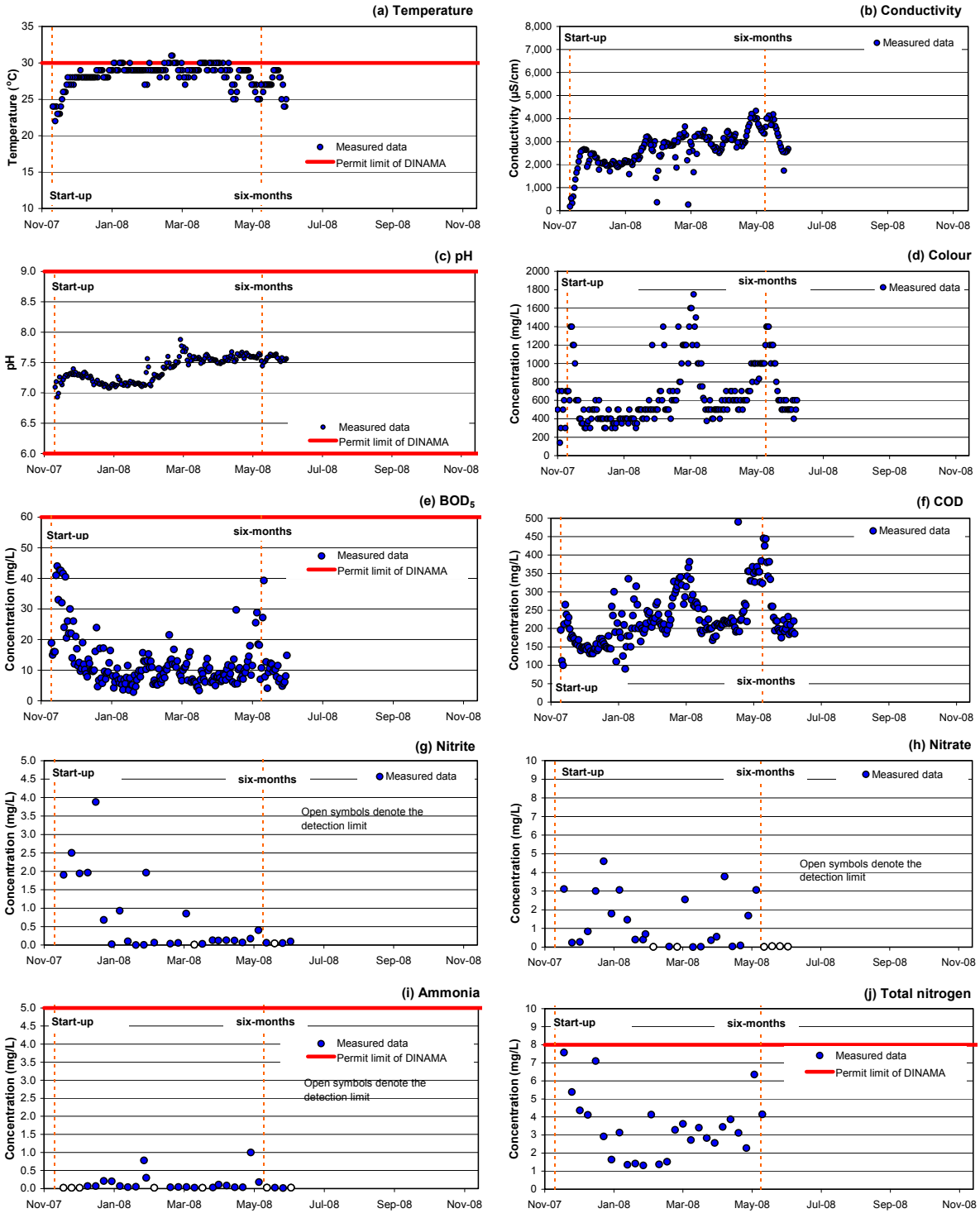
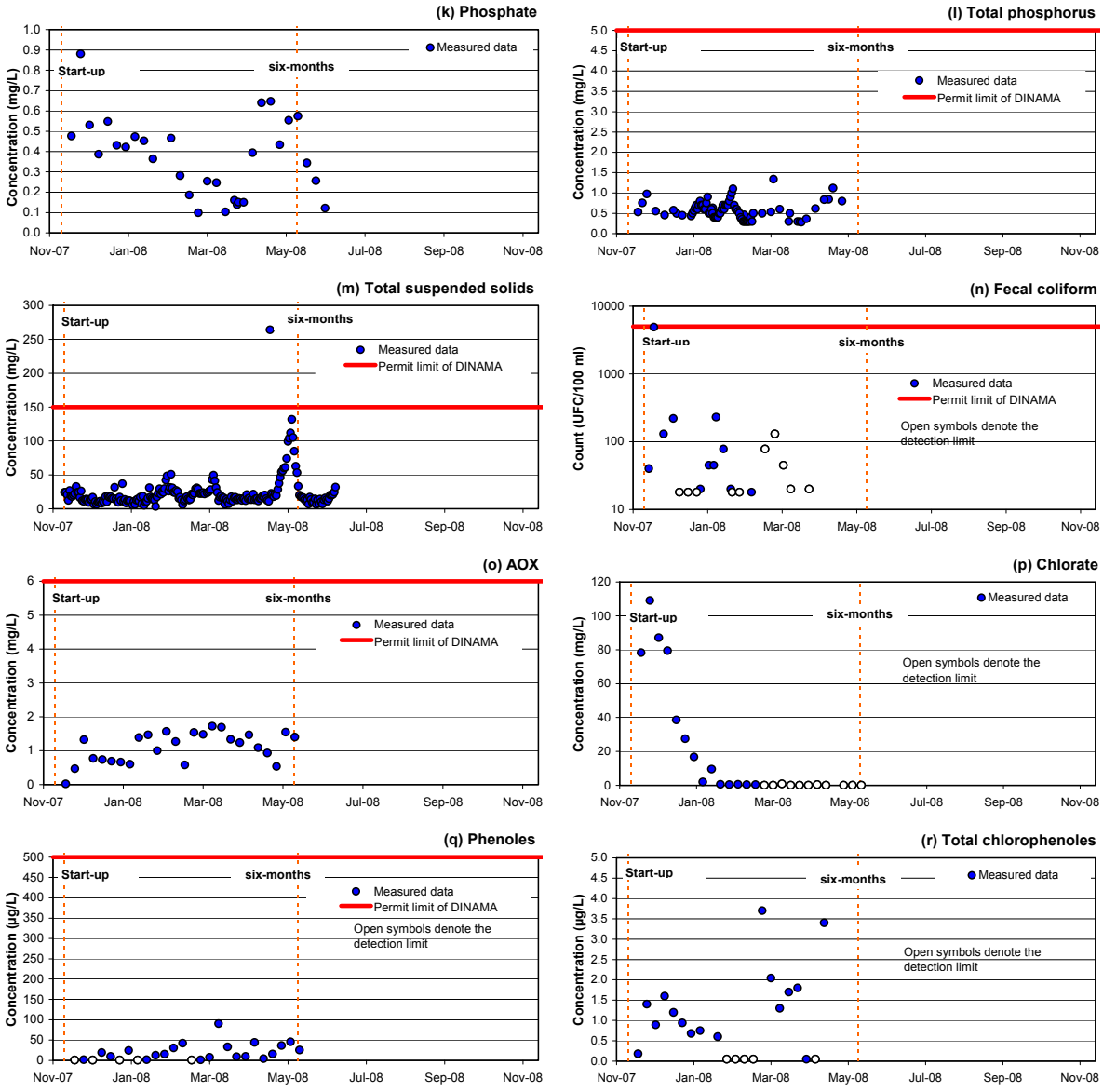


Figure 3.2: Effluent Monitoring Data – Discharge Quality[1]



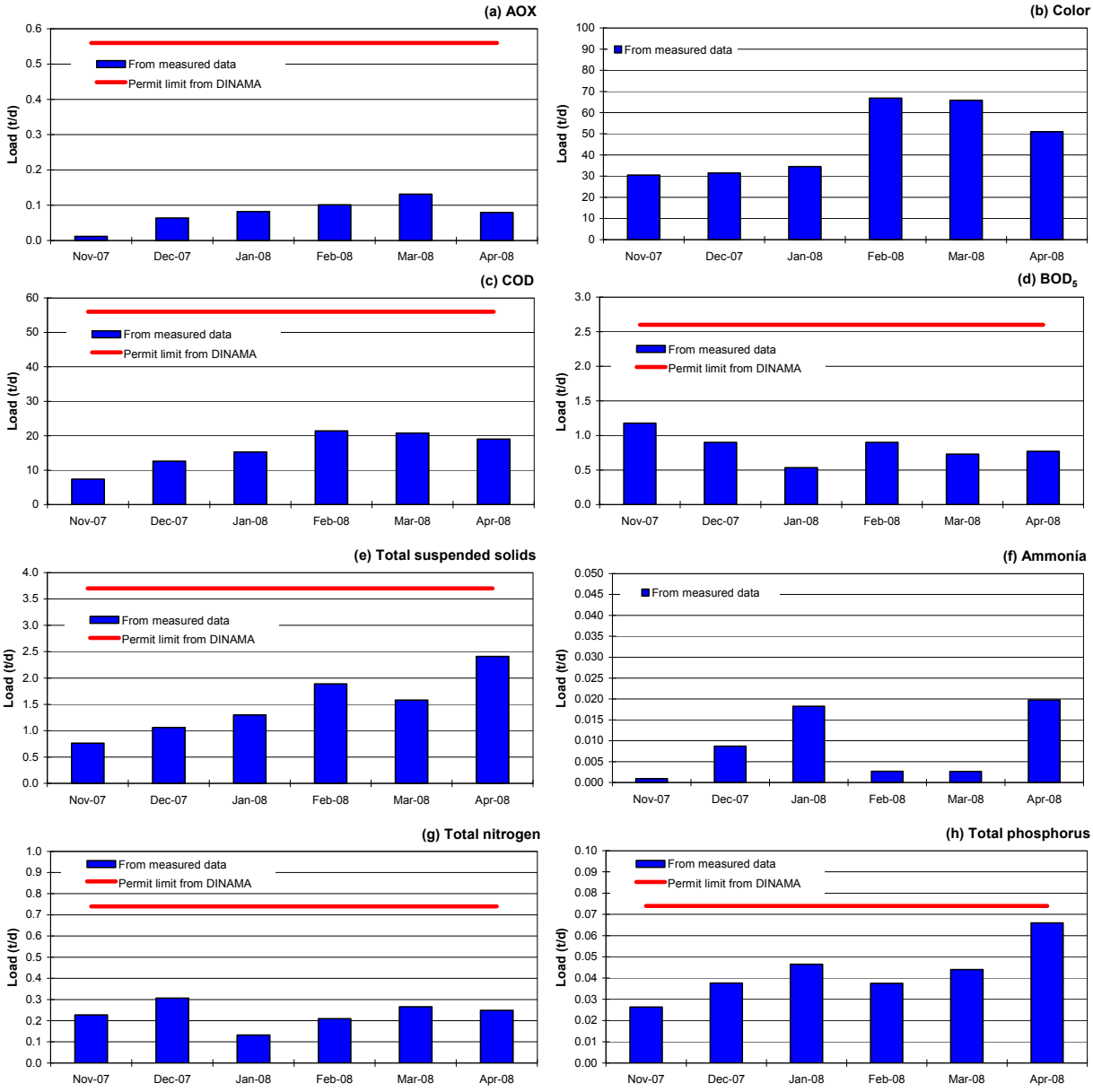
[1] Permit limit of DINAMA – allowable maximum concentration from DINAMA (Autorización de Desagüe Industrial, 4th July 2007)

Figure 3.2: Effluent Monitoring Data – Discharge Quality (continued)[1]



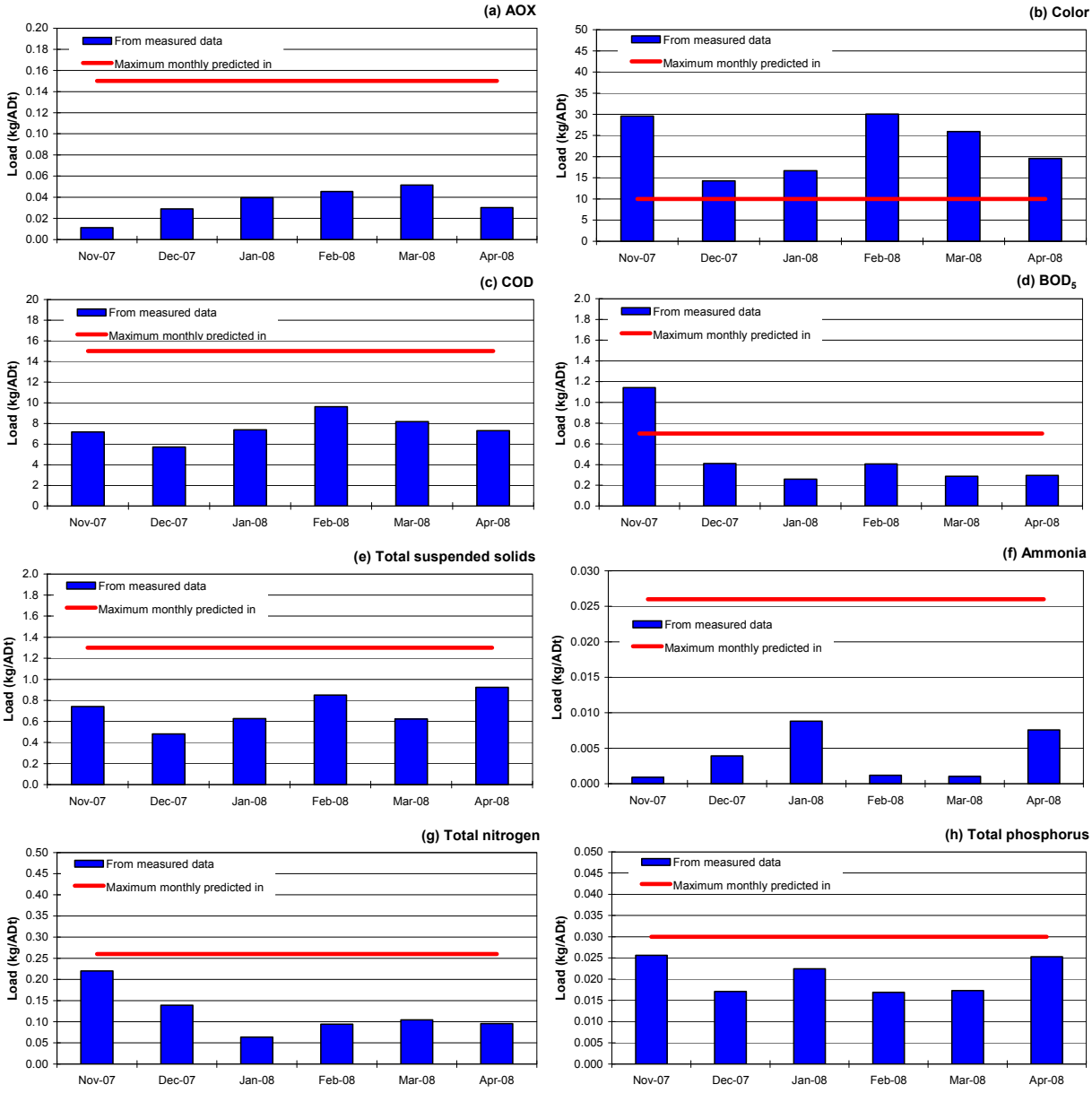
[1] Permit limit of DINAMA – allowable maximum concentration from DINAMA (Autorización de Desagüe Industrial, 4th July 2007)

Figure 3.3: Monthly Average Effluent Load per Day[1]



[1] Permit limit of DINAMA – allowable maximum monthly average load from DINAMA (Autorización de Desagüe Industrial, 4th July 2007)

Figure 3.4: Monthly Average Effluent Load per Unit Production[1]



[1] Expected maximum monthly load from the CIS.

4.0 WATER QUALITY OF THE RIO URUGUAY

4.1 Overview

Water quality of the Río Uruguay is monitored by DINAMA at 17 stations located as illustrated in Figure 4.1. During the first six-months of operation, three surveys were conducted. The first survey was conducted on 11-12 December 2007 at a time when the river flow at the Salto Grande dam ranged from 3,000 m^3/s to 3,500 m^3/s. The second survey was conducted on 12-13 February 2008 when the flow was approximately 690 m^3/s. The third survey was conducted on 15-16 April 2008 when the flow ranged from 2,800 m^3/s to 5,400 m^3/s. Based on historic data, the February 2008 survey is representative of a fairly typical summer low flow period, whereas the December and April surveys are representative of moderate flow conditions. These data are presented in Figure 4.2 and summarized in Table 4.1 for metals and Table 4.2 for dioxin and furan.

Water quality is also monitored by the OSE, who are responsible for the treatment and distribution of potable water to the community of Fray Bentos. Water quality is routinely measured of the raw water supply which is drawn from the Río Uruguay approximately 5 km downstream from the mill and approximately 70 m from the shoreline. Data are available from OSE for the periods pre- and post-start-up of the mill, as presented in Table 4.3.

These data are evaluated in the following sections to determine the potential effect of the effluent discharge on the water quality of the Río Uruguay. Data are compared to surface water quality criteria, baseline water quality, and between upstream and downstream monitoring stations in order to classify the water quality and quantify any potential temporal or spatial change. These data are also compared to predictions from the CIS in Tables 4.4 through 4.7 to verify its conclusions.

The main findings are summarized in the following points:

- The water of the Río Uruguay is considered to be of high quality since the concentrations of most indicator parameters are well below the most restrictive of the applicable Uruguayan and CARU standards. These parameters include: pH, dissolved oxygen, BOD_5, nitrate, turbidity, fluoride, chloride, sulfate, R.A.S., cyanide, arsenic, boron, copper, chromium, mercury, nickel, zinc, and total phenols. As noted in the CIS, exceptions include bacteria, total phosphorus and iron, which exceeded the most restrictive standard prior to commissioning of the mill due to natural and anthropogenic sources throughout the watershed.
- A comparison of the monitoring data pre- and post-commissioning of the mill shows that the water quality of the Río Uruguay has not changed as a result of the mill. Only conductivity and AOX show a small increase in the immediate vicinity of the diffuser, which indicates the presence of mill effluent at a dilution in the range 125:1 to 170:1.
- The water quality between the mill and Fray Bentos is comparable to the water quality further upstream beyond the influence of the mill indicating that the mill has not affected water quality within the Río Uruguay.

- The CIS concluded that the water quality within the Río Uruguay would remain in compliance with surface water quality standards of DINAMA and CARU (with the noted exception of total phosphorus due to its high baseline concentration due to natural and anthropogenic sources throughout the watershed); and that trace levels of wastewater from the mill would not adversely affect water quality. The water quality monitoring results from DINAMA confirm these conclusions.

4.2 Comparison to Water Quality Criteria

Water quality standards have been established by DINAMA and CARU to ensure protection of the beneficial use of the resource. The most restrictive water quality criteria have been established to protect aquatic life and to permit domestic water use. The most restrictive water quality criteria of either DINAMA or CARU are denoted in Figure 4.2.

Based on these data, it is concluded that the water of the Río Uruguay is considered to be of high quality. For most parameters, the water quality is significantly better than the most restrictive criteria. These parameters include: pH, dissolved oxygen, BOD_5, nitrate, turbidity, fluoride, chloride, sulfate, R.A.S., cyanide, arsenic, boron, copper, chromium, mercury, nickel, zinc, and total phenols. The few exceptions are discussed below.

Bacteria levels (fecal coliform, enterococos and E. coli) are below the most restrictive standard (i.e., CARU, Use 2, Recreation) at most monitoring stations, although the standard is exceeded at monitoring stations located along the waterfront of the City of Fray Bentos (Stations 10, 12 and 13). These elevated levels are attributed to sources of bacteria from within the urban areas of the city, and are not attributed to the effluent discharge from the mill since the observed levels far exceed the levels measured in the treated wastewater from the mill.

Total phosphorus levels ranged from 0.03 mg/L to 0.07 mg/L during the December 2007 and February 2008 field surveys, which is comparable to the baseline levels previously reported for the Río Uruguay. As discussed in Section 4.3 and shown in Appendix A, the baseline concentration of total phosphorus (prior to commissioning the mill) ranged from 0.03 mg/L to 0.11 mg/L near Fray Bentos from 2005 to 2006 (Table A-4), and ranged from 0.02 mg/L to 0.31 mg/L at Salto from 1987 to 1990 (Table A-1). These levels exceed the most restrictive Uruguayan standard for total phosphorus, and are attributed to natural and anthropogenic sources derived throughout the watershed of the Río Uruguay, which extends over approximately 365,000 km^2 through portions of Uruguay, Argentina and Brazil. The present and past levels of total phosphorus are not attributed to the mill effluent discharge.

Iron levels exceeded the most restrictive standard (CARU, Use 1, Drinking water) at all monitoring stations during the December 2007 survey and at four monitoring stations during the February 2008 survey. Baseline water quality data collected by Botnia in 2004 (Appendix A, Table A-2) report levels of iron that also exceed this standard. The high baseline level for iron is attributed to the geological characteristics of the watershed rather than anthropogenic sources, and is not attributed to the mill effluent discharge.

The concentration of cadmium and lead are below the most restrictive Uruguayan water quality standard. The classification with respect to the CARU standard is uncertain for cadmium, lead and selenium since the analytical detection limit for these parameters was greater than the CARU standard.

4.3 Comparison to the Baseline Water Quality

The baseline water quality within the Río Uruguay was measured by Botnia at four locations along the river and on seven occasions over the period April 2005 to March 2006 (Table A-4). The 25th and 75th percentile of these observed values are delineated in Figure 4.2 for comparison to the December 2007 and February 2008 field survey data. Other baseline water quality data summarized in the CIS are reproduced in Appendix A.

The comparison of monitoring data pre- and post-start-up shows that the water quality characteristics of the Río Uruguay have not changed as a result of the discharge of mill effluent.

For most parameters, the concentrations have remained within the general range observed during the 2005-06 baseline monitoring period. These parameters include BOD_5, TSS, total nitrogen, nitrates, nitrites, turbidity and hardness.

For several parameters, the concentrations are comparable to the 2005-06 baseline although the concentration at one or more monitoring stations may be higher or lower than the 2005-06 baseline during one or both surveys. These parameters include conductivity, temperature, dissolved oxygen, fecal coliform, phosphate, total phosphorus, ammonia and AOX.

Measured conductivity is comparable to the 2005-06 baseline at all monitoring locations with the exception of two. Conductivity at the bottom of the river in the immediate vicinity of the diffuser (Station 7) is elevated above the 2005-06 baseline, possibly indicating measureable levels of effluent. Conductivity is also elevated near the shoreline of Yaguareté (Station 10) due to the natural outflow from Ayo Yaguareté.

Temperature is within the range of the 2005-06 baseline or shows a slight increase over the 2005-06 baseline near the surface at four monitoring stations – near Isla Abrigo upstream of the Botnia discharge, at the Botnia discharge, and two stations downstream from the discharge near Las Cañas. Since conductivity is not also elevated at these same locations, the observed increase in temperature cannot be attributed to the mill discharge.

The 2005-06 baseline shows dissolved oxygen in the range 8.3 mg/L to 8.8 mg/L, and data from CARU (Appendix A, Table A-3) shows baseline dissolved oxygen in the range 6.6 mg/L to 9.0 mg/L near Fray Bentos and 6.4 mg/L to 7.8 mg/L near the Río Gualeguaychú. In comparison, the monitoring data from December 2007 and February 2008 show a range from 6.9 mg/L to 10.2 mg/L. These values are consistent with those observed prior to commissioning of the mill, and therefore there is no indication of any potential effect on dissolved oxygen levels within the Río Uruguay due to the mill discharge.

Fecal coliform levels were generally well below the 2005-06 baseline levels, although the levels downstream of Fray Bentos (Station 13) were elevated above baseline. This would indicate that the increase in fecal coliform levels is sourced within the city of Fray Bentos and not attributed to the mill.

Total phosphorus levels were generally lower post-start-up as compared to the 2005-06 baseline. Concentrations during the December 2007 and February 2008 survey ranged from 0.03 mg/L to 0.07 mg/L in comparison to the 2005-06 baseline which ranged from 0.03 mg/L to 0.11 mg/L (Table A-4). Higher phosphorus levels were recorded along the waterfront of the City of Fray Bentos (Stations 10, 12 and 13), indicating sources from

within the urban area and the municipal discharge of the city. The planned treatment of the municipal wastewater at the Orion mill will reduce these levels. The highest total phosphorus levels were observed at mid-channel across from Las Cañas (Station 15) and downstream from the confluence with the Río Gualeguaychú. The elevated levels of total phosphorus observed at these four locations are not attributed to the mill since conductivity is not elevated at these same locations and since the levels remain within the range observed prior to the commissioning of the mill.

Ammonia levels were generally below the 2005-06 baseline levels. The only exception was the ammonia concentration along the shoreline downstream from the City of Fray Bentos, which was within the range of the 2005-06 baseline. This may indicate sources of ammonia from within the urban area and the municipal discharge for the city. The planned treatment of the municipal wastewater at the Orion mill would reduce these levels.

AOX levels were generally above the 2005-06 baseline levels at most monitoring stations both upstream and downstream from the mill. The values recorded in December 2007 were of unconfirmed accuracy since the reported concentrations were unrealistically high and far exceeded the concentration of the mill effluent. The values recorded in February 2008 were elevated above baseline possibly indicating trace levels of mill effluent near the diffuser.

4.4 Comparison of Upstream and Downstream Data

The water quality at monitoring stations upstream (Stations 1 through 6) and downstream (Stations 8 through 16) of the mill discharge are comparable. A statistical analysis of the available data shows that the concentration of most parameters is not significantly different between upstream and downstream monitoring stations at the 95% confidence level. These parameters include: temperature, conductivity, pH, sechi depth, dissolved oxygen, bacteria, BOD_5, TSS, phosphate, total phosphorus, organic nitrogen, total nitrogen, nitrite, nitrate, ammonia, AOX, color, turbidity, alkalinity, calcium, hardness, magnesium, sodium, potassium, fluoride, chloride, sulfate, silica, silicon, R.A.S, total cyanide, arsenic, boron, cadmium, copper, chromium, iron, mercury, nickel, lead, selenium, zinc, and total phenols.

The data indicate an increase in the level of bacteria and total phosphorus across the waterfront of the City of Fray Bentos, and an increase in the level of ammonia downstream from the city. As discussed above, this may indicate sources of bacteria, total phosphorus and ammonia from within the urban area and the municipal discharge of the city. The planned treatment of the municipal wastewater at the Orion mill will reduce these levels.

4.5 Comparison to CIS Model Predictions

The CIS utilized comprehensive mathematical models to investigate the potential effects of the mill discharge on the aquatic environment within the Río Uruguay. The investigation concluded that the mill discharge would have minimal effect on water quality within the Río Uruguay under both average and extreme low flow conditions. The CIS recommended monitoring of water quality to verify this conclusion.

The monitoring data obtained by DINAMA during the first six-months of mill operation provides preliminary verification. The conditions experienced during the December 2007 and February 2008 field surveys approximately reflect the conditions represented by the average flow scenario and extreme low flow scenario described in the CIS.

4.5.1 Receptor 1, Río Uruguay at the Botnia Diffuser

The CIS concluded that the diffuser for the Botnia mill would achieve a high degree of mixing within its immediate vicinity, and that the water quality would comply with surface water quality standards of DINAMA and CARU beyond a relatively small and confined mixing zone. The monitoring data obtained by DINAMA during the February 2008 field program verifies this conclusion under moderate flows and typical summer low flows.

DINAMA measured the water quality within the immediate vicinity of the diffuser (Station 7) during the February 2008 field program. The results, shown in Table 4.4 and Figure 4.2, verify that the water quality complies with the most restrictive water quality standard with few exceptions. As described above, these exceptions are attributed to elevated baseline levels within the Río Uruguay and are unrelated to the mill discharge.

For most parameters, the concentrations measured at the diffuser were comparable to or of better quality than the measured water quality at the two monitoring stations (Stations 1 and 2) located near Isla Zapatero, approximately 10 km upstream from the mill. These parameters include color, TSS, dissolved oxygen, bacteria, algae, ammonia, cyanide, phenols, arsenic, cadmium, copper, chromium, mercury, nickel, lead and zinc. For several other parameters, including total nitrogen and nitrate, the concentration at the diffuser was higher than that near Isla Zapatero, however, the concentration of the effluent during the survey was either comparable to or lower than baseline and therefore was unrelated to the observed increase.

Conductivity and AOX show an increase between the diffuser and Isla Zapatero which could be attributed to the mill effluent. Based on the quality of effluent at the time of the field survey, the dilution is estimated to be in the range 125:1 to 170:1. In comparison, the CIS estimated that the dilution within the immediate vicinity of the diffuser would be 100:1. The difference is attributed to the higher flow in the Río Uruguay during the February 2008 field survey (690 m^3/s) as compared to the extreme low flow (500 m^3/s) used for the CIS. A higher flow in the river would enhance the mixing of the effluent and hence cause greater dilution.

Total phosphorus also shows an increase between the diffuser and Isla Zapatero, although the low precision of the measurement precludes a definitive evaluation. The potential change in total phosphorus associated with the mill discharge is less than the precision of the field measurement and within the natural variability observed within the Río Uruguay.

These results confirm the conclusions of the CIS and demonstrate that the mill has negligible effect on water quality within the immediate vicinity of the diffuser.

4.5.2 Receptor 2, Río Uruguay at Yaguareté Bay

The CIS concluded that: the water quality within Yaguareté Bay would remain in compliance with surface water quality standards of DINAMA and CARU (with the exception of total phosphorus due to its high baseline concentration due to natural and anthropogenic sources throughout the watershed); and that trace levels of wastewater from the mill would not adversely affect water quality. The water quality monitoring results from DINAMA confirm these conclusions.

As shown in Table 4.5 and in Figure 4.2, measured water quality within Yaguareté Bay (Station 9) complies with the most restrictive water quality standard (with the same exception as previously discussed). Water quality within Yaguareté Bay is indistinguishable from water quality near Isla Zapatero for most parameters, including color, TSS, dissolved oxygen, BOD_5, nitrate, total nitrogen, ammonia, cyanide, phenols, arsenic, cadmium, copper, chromium, mercury, nickel, lead and zinc. Conductivity and AOX potentially show trace levels of effluent but less than predicted in the CIS.

4.5.3 Receptor 4, Río Uruguay at Water Intake

The monitoring results from DINAMA confirm the conclusion of the CIS that the quality of the drinking water supply for the City of Fray Bentos would remain protected. The available monitoring data, presented in Table 4.6 and Figure 4.2, shows that the quality of water at the intake complied with the drinking water standards for all parameters (with the exception of total phosphorus due to high baseline levels due to natural and anthropogenic sources throughout the watershed). The quality of water at the location of the freshwater intake for the city is indistinguishable from the water quality at Isla Zapatero for all parameters, including TSS, conductivity, dissolved oxygen, BOD_5, AOX, bacteria, ammonia, total phosphorus, cyanide, phenols, arsenic, cadmium, copper, chromium, mercury, nickel, lead and zinc.

Color differs slightly between the intake location and Isla Zapatero but the difference is within the precision of the measurement. Total nitrogen and nitrate also differs slightly between the two locations but this difference is not attributed to the mill effluent as previously discussed.

4.5.4 Receptor 10, Río Uruguay along the Argentina Side

The CIS concluded that the water quality along the Argentina side of the Río Uruguay was unaffected by the mill discharge. This conclusion is confirmed by the monitoring data of DINAMA. Water quality was measured along the centre channel of the Río Uruguay at river marker 100 km. The data (Table 4.7 and Figure 4.2) shows that the water quality at this location is indistinguishable from the water quality at Isla Zapatero for all parameters including TSS, conductivity, dissolved oxygen, BOD_5, AOX, bacteria, total nitrogen, nitrate, ammonia, total phosphorus, cyanide, phenols, arsenic, cadmium, copper, chromium, mercury, nickel, lead and zinc.

4.6 Comparison of Freshwater Supply Pre- and Post-Start-up

The City of Fray Bentos obtains its drinking water from the Río Uruguay. The water intake is located approximately 5 km downstream from the Botnia mill, and approximately 70 m into the Río Uruguay. Freshwater is supplied to the community by the OSE, who are responsible for the treatment and distribution of the water.

OSE also monitors the quality of the raw water supply. A summary of these data for the period pre- and post-start-up are presented in Table 4.3. As shown, the quality of the raw water supply is unaffected by the discharge from the mill. The water quality pre- and post-start-up is comparable for most parameters including color, turbidity, pH, alkalinity, chloride, nitrite, ammonia, conductivity, total organic carbon (TOC), dissolved organic carbon (DOC),

total phosphorus, trihalomethane, total coliforms, total Kjeldahl nitrogren (TKN), total nitrogen, and AOX. Elevated levels of phenolic substances were measured on 15 and 29 January 2008 in the raw water supply, although the mill does not appear to be the source since the concentration of phenols in the effluent was less than that measured in the raw water at the time. These monitoring data will be evaluated further in the subsequent monitoring reports.

Table 4.1: Summary of Water Quality for Metals at Monitoring Stations along the Río Uruguay

STATION	N°	Arsenic	Boron	Cadmium	Copper	Chrome	Iron	Mercury	Nickel	Lead	Selenium	Zinc
	0	µg /l	mg /l	µg /l	µg /l	µg /l	mg /l	µg /l	µg /l	µg /l	µg /l	µg /l
							Dec-2007					
E of island Zapatero, center of channel	1	< 5	< 0.05	< 1	< 10	< 10	1.9	< 0.2	< 20	< 30	< 10	< 5
5 km upstream of M'bopicuá	2	< 5	< 0.05	< 1	< 10	< 10	1.7	< 0.2	< 20	< 30	< 10	< 5
Infront of the former location of M'Bopicuá	3	< 5	< 0.05	< 1	< 10	< 10	1.7	< 0.2	< 20	< 30	< 10	< 5
Inlet off Island Abrigo	4	< 5	< 0.05	< 1	< 10	< 10	2.2	< 0.2	< 20	< 30	< 10	< 5
Main channel infront of Island Abrigo	5	< 5	< 0.05	< 1	< 10	< 10	1.8	< 0.2	< 20	< 30	< 10	< 5
Costa uru. infront of Island Abrigo	6	< 5	< 0.05	< 1	< 10	< 10	1.7	< 0.2	< 20	< 30	< 10	< 5
At diffuser for Botnia	7	< 5	< 0.05	< 1	< 10	< 10	1.6	< 0.2	< 20	< 30	< 10	< 5
Adjacent to the diffuser of Botnia	8	< 5	< 0.05	< 1	< 10	< 10	2.0	< 0.2	23	< 30	< 10	< 5
E of Ayo Yaguareté	9	< 5	< 0.05	< 1	< 10	< 10	1.9	< 0.2	< 20	< 30	< 10	< 5
W of Ayo Yaguareté	10	< 5	< 0.05	< 1	< 10	< 10	1.7	< 0.2	< 20	< 30	< 10	< 5
Water intake of OSE	11	< 5	< 0.05	< 1	< 10	< 10	1.7	< 0.2	< 20	< 30	< 10	< 5
Marker 100 km, main channel of the Uruguay r	12	< 5	< 0.05	< 1	< 10	< 10	1.8	< 0.2	< 20	< 30	< 10	< 5
Municipal wastewater discharge	13	< 5	< 0.05	< 1	< 10	< 10	1.7	< 0.2	< 20	< 30	< 10	< 5
Downstream from Brio Las Cañas	14	< 5	< 0.05	< 1	< 10	< 10	1.8	< 0.2	< 20	< 30	< 10	< 5
Offshore from Brio Las Cañas	15	< 5	< 0.05	< 1	< 10	< 10	1.9	< 0.2	< 20	< 30	< 10	< 5
							Feb-2008					
STATION	N°	Arsenic	Boron	Cadmium	Copper	Chrome	Iron	Mercury	Nickel	Lead	Selenium	Zinc
	0	µg /l	mg /l	µg /l	µg /l	µg /l	mg /l	µg /l	µg /l	µg /l	µg /l	µg /l
E of island Zapatero, center of channel	1	< 5	< 0.05	1	< 3	< 3	0.91	< 0.2	< 6	< 30	< 10	< 5
5 km upstream of M'bopicuá	2	< 5	< 0.05	1	< 10	< 3	0.84	< 0.2	< 6	< 30	< 10	< 5
Infront of the former location of M'Bopicuá	3	< 5	< 0.05	< 1	< 3	< 3	0.79	< 0.2	< 6	< 30	< 10	< 5
Inlet off Island Abrigo	4	< 5	< 0.05	< 1	< 10	< 3	1.20	< 0.2	< 6	< 30	< 10	< 3
Main channel infront of Island Abrigo	5	< 5	< 0.05	< 1	< 3	< 3	0.73	< 0.2	< 6	< 30	< 10	< 5
Costa uru. infront of Island Abrigo	6	< 5	< 0.05	< 1	< 3	< 3	0.80	< 0.2	< 20	< 30	< 10	< 3
At diffuser for Botnia	7	< 5	< 0.05	< 1	< 3	< 3	0.81	< 0.2	6	< 30	< 10	< 3
Adjacent to the diffuser of Botnia	8	< 5	< 0.05	< 1	< 3	< 3	0.69	< 0.2	< 20	< 30	< 10	< 3
E of Ayo Yaguareté	9	< 5	< 0.05	< 1	< 3	< 3	0.78	< 0.2	< 20	< 30	< 10	< 5
W of Ayo Yaguareté	10	< 5	0.115	< 1	< 3	< 3	1.20	< 0.2	< 6	< 30	< 10	< 5
Water intake of OSE	11	< 5	0.074	< 1	< 3	< 3	0.80	< 0.2	< 20	< 30	< 10	< 3
Marker 100 km, main channel of the Uruguay r	12	< 5	0.058	< 1	< 3	< 3	0.82	< 0.2	< 20	< 30	< 10	< 5
Municipal wastewater discharge	13	< 5	< 0.05	< 1	< 3	< 3	1.10	< 0.2	< 6	< 30	< 10	< 5
Downstream from Brio Las Cañas	14	< 5	< 0.05	1	< 3	< 3	0.78	< 0.2	< 6	< 30	< 10	< 5
Offshore from Brio Las Cañas	15	< 5	< 0.05	1.1	< 3	< 3	1.10	< 0.2	< 20	< 30	< 10	< 5
							Apr-2008					
STATION	N°	Arsenic	Boron	Cadmium	Copper	Chrome	Iron	Mercury	Nickel	Lead	Selenium	Zinc
	0	µg /l	mg /l	µg /l	µg /l	µg /l	mg /l	µg /l	µg /l	µg /l	µg /l	µg /l
E of island Zapatero, center of channel	1	< 5	< 0.05	< 1	< 10	< 3	0.87	< 0.2	< 20	< 30	< 10	< 3
5 km upstream of M'bopicuá	2	< 5	< 0.05	< 1	< 3	< 3	0.98	< 0.2	< 20	< 30	< 10	< 3
Infront of the former location of M'Bopicuá	3	< 5	< 0.05	< 1	10	< 3	0.97	< 0.2	< 20	< 30	< 10	< 3
Inlet off Island Abrigo	4	< 5	< 0.05	< 1	< 3	< 3	2.10	< 0.2	< 20	< 30	< 10	< 5
Main channel infront of Island Abrigo	5	< 5	< 0.05	< 1	< 3	< 3	0.96	< 0.2	< 20	< 30	< 10	8.7
Costa uru. infront of Island Abrigo	6	< 5	< 0.05	< 1	< 10	< 3	1.10	< 0.2	< 20	< 30	< 10	< 3
At diffuser for Botnia	7	< 5	< 0.05	< 1	< 3	< 3	0.93	< 0.2	< 20	< 30	< 10	3
Adjacent to the diffuser of Botnia	8	< 5	< 0.05	< 1	< 10	< 3	1.00	< 0.2	< 20	< 30	< 10	< 3
E of Ayo Yaguareté	9	< 5	< 0.05	< 1	< 3	< 3	1.20	< 0.2	< 20	< 30	< 10	< 3
W of Ayo Yaguareté	10	< 5	< 0.05	< 1	< 10	< 3	1.00	< 0.2	< 20	< 30	< 10	< 3
Water intake of OSE	11	< 5	< 0.05	< 1	< 3	< 3	1.00	< 0.2	< 20	< 30	< 10	< 3
Marker 100 km, main channel of the Uruguay r	12	< 5	< 0.05	< 1	< 10	< 3	1.10	< 0.2	< 20	< 30	< 10	< 3
Municipal wastewater discharge	13	< 5	< 0.05	< 1	< 3	< 3	0.99	< 0.2	< 20	< 30	< 10	< 3
Downstream from Brio Las Cañas	14	< 5	< 0.05	< 1	< 10	< 3	1.10	< 0.2	< 20	< 30	< 10	< 3
Offshore from Brio Las Cañas	15	< 5	< 0.05	< 1	< 10	< 3	1.30	< 0.2	< 20	< 30	< 10	< 3

Table 4.2: Summary of Water Quality for Dioxin and Furan at Monitoring Stations along the Río Uruguay

Parameter	Unit	Nov-07				Dec-07				Jan-08				Feb-08				Mar-08			
		Puente código	Botnia código	Las Cañas	Nuevo Berlin código	Puente código	Botnia código	Las Cañas	Nuevo Berlin código	Puente código	Botnia código	Las Cañas	Nuevo Berlin código	Puente código	Botnia código	Las Cañas	Nuevo Berlin código	Puente código	Botnia código	Las Cañas	Nuevo Berlin código
Dioxin																					
2,3,7,8-TCDD	pg/L	<0.21	<0.22	<0.35	<0.36	<0.45	<0.3	<0.36	<0.35	<0.14	<0.096	<0.14	<0.11	<0.073	<0.11	<0.098	<0.056	<0.098	<0.099	<0.12	<0.06
1,2,3,7,8-PeCDD	pg/L	<0.54	<0.45	<0.37	<0.61	<0.45	<0.39	<0.38	<0.64	<0.27	<0.18	<0.25	<0.21	<0.29	<0.3	<0.49	<0.19	<0.43	<0.37	<0.35	<0.22
1,2,3,4,7,8-HxCDD	pg/L	<0.27	<0.51	<0.85	<0.79	<0.51	<0.44	<0.39	<0.54	<0.5	<0.25	<0.58	<0.42	<0.29	<0.42	<0.53	<0.42	<0.66	<0.57	<0.65	<0.31
1,2,3,6,7,8-HxCDD	pg/L	<0.67	<0.55	<0.95	<0.85	<0.48	<0.42	<0.39	<0.48	<0.49	<0.25	<0.57	<0.41	<0.3	<0.39	<0.54	<0.43	<0.7	<0.56	<0.64	<0.34
1,2,3,7,8,9-HxCDD	pg/L	<0.57	<0.51	<0.85	<0.79	<0.52	<0.46	<0.4	<0.56	<0.49	<0.25	<0.58	<0.41	<0.29	<0.42	<0.53	<0.43	<0.66	<0.58	<0.65	<0.31
1,2,3,4,6,7,8-HpCDD	pg/L	<0.86	<0.86	<1.2	<1.3	<0.62	<0.61	<0.56	<0.79	<0.58	<0.33	<0.58	<0.4	<0.47	<0.65	<0.97	<0.45	<0.83	<0.86	<1.6	<0.44
1,2,3,4,6,7,8,9-OCDD	pg/L	<1.9	<2.1	<2.2	<4.3	<1.4	<1.4	<1.3	<2.	<1.3	<1.1	<1.2	<0.9	<1.3	<1.7	<2.1	<1.4	<1.9	<1.4	<2.4	<1.1
Furan																					
2,3,7,8-TCDF	pg/L	<0.24	<0.25	<0.37	<0.36	<0.22	<0.15	<0.18	<0.21	<0.1	<0.1	<0.1	<0.1	<0.081	<0.13	<0.16	<0.062	<0.11	<0.14	<0.16	<0.064
1,2,3,7,8-PeCDF	pg/L	<0.2	<0.23	<0.28	<0.31	<0.18	<0.19	<0.2	<0.28	<0.5	<0.5	<0.5	<0.5	<0.082	<0.11	<0.13	<0.089	<0.13	<0.15	<0.13	<0.11
2,3,4,7,8--PeCDF	pg/L	<0.18	<0.22	<0.37	<0.37	<0.26	<0.13	<0.14	<0.22	<0.4	<0.4	<0.4	<0.4	<0.2	<0.072	<0.12	<0.081	<0.16	<0.13	<0.13	<0.2
1,2,3,4,7,8-HxCDF	pg/L	<0.26	<0.29	<0.38	<0.39	<1.2	<0.19	<0.17	<0.24	<1.	<1.	<1.	<1.	<1.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,2,3,6,7,8-HxCDF	pg/L	<0.3	<0.27	<0.4	<0.34	<0.21	<0.19	<0.16	<0.13	<0.5	<0.5	<0.5	<0.5	<0.2	<0.21	<0.25	<0.15	<0.26	<0.25	<0.26	<0.13
2,3,4,6,7,8-HxCDF	pg/L	<0.38	<0.47	<0.6	<0.73	<0.33	<0.3	<0.25	<0.36	<0.34	<0.25	<0.37	<0.25	<0.22	<0.32	<0.41	<0.24	<0.4	<0.37	<0.45	<0.19
1,2,3,7,8,9-HxCDF	pg/L	<0.62	<0.65	<0.86	<0.84	<0.52	<0.49	<0.42	<0.58	<0.48	<0.33	<0.51	<0.35	<0.35	<0.49	<0.68	<0.34	<0.6	<0.58	<0.69	<0.3
1,2,3,4,6,7,8-HpCDF	pg/L	<0.36	<0.4	<0.5	<0.5	<1.	<1.	<1.	<1.	<1.	<1.	<1.	<1.	<1.	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<1.
1,2,3,4,7,8,9-HpCDF	pg/L	<0.97	<0.98	<1.3	<1.1	<0.6	<0.74	<0.55	<0.61	<0.44	0.411	<0.41	<0.35	<0.36	<0.44	<0.58	<0.39	<0.47	<0.7	<0.63	<0.37
1,2,3,4,6,7,8,9-OCDF	pg/L	<2.2	<2.3	<2.9	<2.8	<1.7	<1.6	<1.5	<1.7	<2.	<2.	<2.	<2.	<0.73	<1.4	<1.5	<0.83	<1.1	<1.2	<1.7	<0.76
Toxic Equivalent, I-TEQ																					
Iincluding detection limit	pg/L	<0.97	<0.94	<1.43	<1.41	<1.24	<0.86	<0.89	<1.13	<0.91	<0.72	<0.93	<0.8	<0.62	<0.61	<0.8	<0.47	<0.81	<0.74	<0.8	<0.51
excluding detection limit	pg/L	-	-	-	-	-	-	-	-	-	0.004	-	-	-	-	-	-	-	-	-	-
Toxic Equivalent, WHO-TEQ																					
Iincluding detection limit	pg/L	<1.23	<1.16	<1.75	<1.71	<1.46	<1.05	<1.08	<1.45	<1.05	<0.81	<1.06	<0.91	<0.76	<0.76	<1.04	<0.56	<1.02	<0.92	<0.97	<0.62
excluding detection limit	pg/L	-	-	-	-	-	-	-	-	-	0.004	-	-	-	-	-	-	-	-	-	-

Table 4.3: Summary of Potable Water Quality for the City of Fray Bentos

		Pre-Start-up (18 April 2007 to 06 November 2007)			Post-Start-up (13 November 2007 to 18 April 2008)		
Aqua Bruta (Raw Water)	**Units**	**Minimum Value**	**Maximum Value**	**Average**	**Minimum Value**	**Maximum Value**	**Average**
Color (true)	U Pt - Co	7	98	43	10	90	46.8
Turbidity	NTU	13	46	24	9	65	27.1
pH	-	7.1	7.9	7.6	7	8.4	7.5
Oxides	mg/l O_2	1.5	8	4.9	1.6	5.9	3.7
Total Hardness	mg/l $CaCO_3$	27	55	38	20	35	27.5
Hardness, permanent	(mg/l $CaCO_3$	0	24	7	0	4	1.2
Hardness, temporary	mg/l $CaCO_3$	20	40	31	19	35	26.4
Alkalinity, total	mg/l $CaCO_3$	20	40	31	19	38	28.9
Alkalinity, carbonate	mg/l $CaCO_3$	0	0	0	0	0	0
Chloride	mg/l Cl	1.4	5.4	2.9	1.5	3.5	2.2
Nitrite	mg/l NO_2	<0.01	<0.01	<0.01	<0.02	<0.02	<0.02
Ammonia	mg/l NH_4	0.04	0.13	0.06	<0.1	0.13	<0.1
Conductivity	µS/cm 25º C	65	99	80	56.3	103	71
TOC	mg/l C	1.24	4.7	2.76	0.6	3.3	1.8
DOC	mg/l C	1.66	5.04	2.92	1.8	2.7	2.2
Absorbancia (254 nm)	-	0.211	0.556	0.35	0.112	0.269	0.196
SUVA (Absorbancia/DOC)	-	0.08	0.184	0.13	0.068	0.111	0.089
Total phosphorus (mg/l P)	mg/l P	0.051	0.109	0.08	0.04	0.24	0.08
Trihalometan $CHBr_3$	µg/l	<1	<1	<1	n.d	n.d	n.d
Trihalometan $CHClBr_2$	µg/l	<1	<1	<1	n.d	n.d	n.d
Trihalometan $CHCl_3$	µg/l	<1	<1	<1	n.d	n.d	n.d
Trihalometan $CHCl_2Br$	µg/l	<1	<1	<1	n.d	n.d	n.d
Total coliforms	NMP/100 ml	273	6500	1838	435	6900	2422
Coliformes Termotolerantes	NMP/100 ml	10	121	39	<1	52	11
Nitrogen Kjeldahl	mg/l N	0.2	0.62	0.37			
Nitrogen Total	mg/l N	0.79	1.49	1.05	0.56	1.49	0.97
Phenolic substances	µg/l fenol	<1	<1	<1	n.d	20.7	4.5
AOX	µg/l Cl	<8.1	17.9	9.8	<8.1	10.8	8.3
Aqua Tratada (Treated Water)	**Units**	**Minimum Value**	**Maximum Value**	**Average**	**Minimum Value**	**Maximum Value**	**Average**
Color (true)	U Pt - Co	<5	5	<5	4.7	6	5.1
Turbidity	NTU	0.2	1.4	0.5	0.2	1,4 (*)	0.4
pH	-	6.5	9.5	7.9	7.3	8.7	7.8
Oxides	mg/l O_2	0.8	3.2	1.2	0.6	1.7	1.3
Chloride	mg/l Cl	4.1	5	4.5	-	-	-
Nitrates	mg/l NO_3	<2.6	<8.1	<4.1	<1.5	<4.1	<3.1
Nitrites	mg/l NO_2	<0.01	<0.01	<0.01	<0,02	<0,02	<0,02
Ammonia	mg/l NH_4	0.04	0.09	0.05	<0,1	<0,1	<0,1
Free residual chlorine	mg/l Cl_2	1	1.2	1.1	0.8	1.3	1.1
Conductivity	µS/cm 25º C	103	205	155	78	171	134
TOC	mg/l C	1.06	2.09	1.59	1.02	2.45	1.5
Total phosphorus (mg/l P)	mg/l P	0.005	0.019	0.01	-	-	-
Nitrogen Total	mg/l N	0.51	0.98	0.78	0.66	0.88	0.79
Trihalometanos $CHBr_3$	µg/l	<1	<1	<1	n.d	n.d	n.d
Trihalometanos $CHClBr_2$	µg/l	<1	<1	<1	n.d	n.d	n.d
Trihalometanos $CHCl_3$	µg/l	12	46	25	13	36	22.5
Trihalometanos $CHCl_2Br$	µg/l	2	7	3	2	6	3.1
Total coliforms	NMP/100 ml	<1	<1	<1	<1	<1	<1
Coliformes Termotolerantes	NMP/100 ml	<1	<1	<1	<1	<1	<1
Pentacloro Fenol	µg/l	-	-	-	n.d	n.d	n.d
Tricloro Fenol	µg/l	-	-	-	n.d	n.d	n.d
Phenolic substances	µg/l fenol	<1	1.6	1.1	-	-	-
AOX	µg/l Cl	<8.1	68	38.3	18.2	374	76.5

Table 4.4: Comparison of Measured and Predicted Water Quality, Río Uruguay near the Botnia Diffuser

Comparison of water quality as measured in February 2008 at the Botnia diffuser (Station 7) to the prediction in Table D6.3-1b of the CIS for at the same location (Receptor #1b) under extreme low flow and monthly maximum effluent loading.							
Parameters	**Units**	**Prediction from CIS**			**Measured by DINAMA**		
		Baseline	**With Mill Discharge**	**Incremental Change**	**Measured at Isla Zapatero**	**Measured at Diffuser**	**Difference**
Conventional							
Temperature	°C	-	-	0.4	26.1	27.2	1.1
TSS	mg/L	8.0	8.6	0.6	<10	<10	0
pH					-	-	-
Conductivity	µS/cm	100	149	49	60	83	22
Color	PtCo	35.0	39.8	4.8	40	40	0
Dissolved oxygen	mg/L	-	-	0	7.4	7.6	0.3
COD	mg/L	6.0	13.4	7.4	-	-	-
BOD	mg/L	0.2	0.6	0.4	<2.2	<2.2	0.0
AOX	mg/L	0.004	0.081	0.077	0.013	0.019	0.006
Oil and grease	mg/L	-	-	0.2	-	-	-
Detergentes	mg/L	-	-	0.0	-	-	-
Microbiological							
Fecal coliform	FC/100 mL	-	-	12	6	1	-5
	FC/100 mL				23	10	-13
Esquistosomiasis					-	-	-
Escherichia coli	per/100 mL				10	10	0
Enterococos	per/100 mL				1	1	0
Algae	UPA/ml				<70	<70	0
Nutrients							
Total nitrogen	mg/L	1.02	1.15	0.13	0.93	1.14	0.21
Nitrates	mg/L	0.63	0.69	0.06	0.42	0.43	0.02
Ammonia	mg/L	0.01	0.02	0.01	0.06	0.05	-0.01
Total phosphorus	mg/L	0.150	0.153	0.003	0.04	0.05	0.01
Toxins							
Chlorates	mg/L	-	-	-	-	-	-
Chlorophenols	mg/L	0.001	0.003	0.001	-	-	-
Cyanide	mg/L	-	-	0.003	<0.005	<0.005	0.000
Phenolic substances	mg/L	<0.040	<0.040	0.000	<0.001	<0.001	0.000
Phytosteroles	mg/L	0.022	0.025	0.003	-	-	-
Resin and fatty acids		-	-	-	-	-	-
Sulphide	mg/L	-	-	0.003	-	-	-
Dioxin/Furan	pq/L TEQ	0.460	<0.583	<0.123	-	-	-
2,3,7,8-TCDD	pq/L	<0.500	<0.506	<0.006	-	-	-
Metals							
Arsenic	mg/L	0.0005	0.0028	0.0023	<0.005	<0.005	0.000
Cadmium	mg/L	0.0010	0.0012	0.0002	<0.001	<0.001	0.000
Copper	mg/L	0.01	0.02	0.00	<0.007	<0.003	-0.004
Chrome	mg/L	0.003	0.007	0.004	<0.003	<0.003	0.000
Mercury	mg/L	0.0005	-	-	<0.0002	<0.0002	<0.0000
Nickel	mg/L	0.003	0.005	0.002	<0.006	<0.006	0.000
Lead	mg/L	0.024	0.025	0.001	<0.030	<0.030	0.000
Zinc	mg/L	0.015	0.016	0.001	<0.005	<0.006	0.001

Table 4.5: Comparison of Measured and Predicted Water Quality, Río Uruguay at Yaguareté Bay

Comparison of water quality as measured in February 2008 in Yaguareté Bay (Station 9) to the prediction in Table D6.3-2b of the CIS for at the same location (Receptor #2) under extreme low flow and monthly maximum effluent loading.							
Parameters	**Units**	**Prediction from CIS**			**Measured by DINAMA**		
		Baseline	**With Mill Discharge**	**Incremental Change**	**Measured at Isla Zapatero**	**Measured at Yaguareté Bay**	**Difference**
Conventional							
Temperature	°C	-	-	0.1	26.1	24.7	-1.4
TSS	mg/L	14.0	14.2	0.2	<10	<10	0
pH					-	-	-
Conductivity	µS/cm	100	114	14	60	70	9
Color	PtCo	35.0	36.4	1.4	40	40	0
Dissolved oxygen	mg/L	-	-	0	7.4	8.3	0.9
COD	mg/L	5.0	7.1	2.1	-	-	-
BOD	mg/L	0.1	0.2	0.1	<2.2	<2.2	0.0
AOX	mg/L	0.004	0.026	0.022	0.013	0.020	0.007
Oil and grease	mg/L	-	-	0.0	-	-	-
Detergentes	mg/L	-	-	0.0	-	-	-
Microbiological							
Fecal coliform	FC/100 mL	-	-	3	6	50	44
	FC/100 mL				23	400	377
Esquistosomiasis					-	-	-
Escherichia coli	per/100 mL				10	10	0
Enterococos	per/100 mL				1	3	2
Algae	UPA/ml				<70	<70	0
Nutrients							
Total nitrogen	mg/L	0.95	0.99	0.04	0.93	0.83	-0.10
Nitrates	mg/L	0.36	0.38	0.02	0.42	0.34	-0.08
Ammonia	mg/L	0.01	0.01	0.00	0.06	0.04	-0.02
Total phosphorus	mg/L	0.220	0.221	0.001	0.04	0.05	0.01
Toxins							
Chlorates	mg/L	-	-	-	-	-	-
Chlorophenols	mg/L	0.001	0.002	0.000	-	-	-
Cyanide	mg/L	-	-	0.001	<0.005	<0.005	0.000
Phenolic substances	mg/L	<0.040	<0.040	0.000	<0.001	<0.001	0.000
Phytosteroles	mg/L	0.022	0.023	0.001	-	-	-
Resin and fatty acids		-	-	-	-	-	-
Sulphide	mg/L	-	-	0.001	-	-	-
Dioxin/furan	pq/L TEQ	0.460	<0.495	<0.035	-	-	-
2,3,7,8-TCDD	pq/L	<0.500	<0.502	<0.002	-	-	-
Metals							
Arsenic	mg/L	0.0005	0.0013	0.0008	<0.005	<0.005	0.000
Cadmium	mg/L	0.0005	0.0006	0.0001	<0.001	<0.001	0.000
Copper	mg/L	0.01	0.01	0.00	<0.007	<0.003	-0.004
Chrome	mg/L	0.003	0.004	0.001	<0.003	<0.003	0.000
Mercury	mg/L	0.0005	-	-	<0.0002	<0.0002	0.0000
Nickel	mg/L	0.003	0.004	0.001	<0.006	<0.020	<0.014
Lead	mg/L	0.005	0.005	0.000	<0.030	<0.030	0.000
Zinc	mg/L	0.011	0.011	0.000	<0.005	<0.005	0.000

Table 4.6: Comparison of Measured and Predicted Water Quality, Río Uruguay at the Water Intake

Comparison of water quality as measured in February 2008 at the Fray Bentos water intake (Station 11) to the prediction in Table D6.3-4b of the CIS for at the same location (Receptor #4) under extreme low flow and monthly maximum effluent loading.							
Parameters	**Units**	**Prediction from CIS**			**Measured by DINAMA**		
		Baseline	**With Mill Discharge**	**Incremental Change**	**Measured at Isla Zapatero**	**Measured at Water Intake**	**Difference**
Conventional							
Temperature	°C	-	-	0.2	26.1	24.6	-1.5
TSS	mg/L	8.0	8.4	0.4	<10	<10	0
pH					-	-	-
Conductivity	µS/cm	100	127	27	60	63	3
Color	PtCo	35.0	37.7	2.7	40	50	10
Dissolved oxygen	mg/L	-	-	0	7.4	7.4	0.1
COD	mg/L	5.0	9.1	4.1	-	-	-
BOD	mg/L	0.5	0.7	0.2	<2.2	<2.2	0.0
AOX	mg/L	0.007	0.050	0.043	0.013	<0.004	-0.009
Oil and grease	mg/L	-	-	0.1	-	-	-
Detergentes	mg/L	-	-	0.0	-	-	-
Microbiological							
Fecal coliform	FC/100 mL	-	-	7	6	8	2
	FC/100 mL				23	40	17
Esquistosomiasis					-	-	-
Escherichia coli	per/100 mL				10	10	0
Enterococos	per/100 mL				1	1	0
Algae	UPA/ml				<70	<70	0
Nutrients							
Total nitrogen	mg/L	0.97	1.04	0.07	0.93	0.95	0.02
Nitrates	mg/L	0.61	0.64	0.03	0.42	0.44	0.03
Ammonia	mg/L	0.26	0.27	0.01	0.06	0.03	-0.03
Total phosphorus	mg/L	0.140	0.142	0.002	0.04	0.04	0.00
Toxins							
Chlorates	mg/L	-	-	-	-	-	-
Chlorophenols	mg/L	0.001	0.002	0.001	-	-	-
Cyanide	mg/L	-	-	0.002	<0.005	<0.005	0.000
Phenolic substances	mg/L	<0.040	<0.040	0.000	<0.001	<0.001	0.000
Phytosteroles	mg/L	0.022	0.024	0.002	-	-	-
Resin and fatty acids		-	-	-	-	-	-
Sulphide	mg/L	-	-	0.001	-	-	-
Dioxin/Furan	pq/L TEQ	0.460	<0.528	<0.068	-	-	-
2,3,7,8-TCDD	pq/L	<0.500	<0.503	<0.003	-	-	-
Metals							
Arsenic	mg/L	0.0005	0.0020	0.0015	<0.005	<0.005	0.000
Cadmium	mg/L	0.0005	0.0007	0.0002	<0.001	<0.001	0.000
Copper	mg/L	0.01	0.01	0.00	<0.007	<0.003	-0.004
Chrome	mg/L	0.003	0.005	0.002	<0.003	<0.003	0.000
Mercury	mg/L	0.0004	-	-	<0.0002	<0.0002	0.0000
Nickel	mg/L	0.003	0.004	0.001	<0.006	<0.020	<0.014
Lead	mg/L	0.005	0.006	0.001	<0.030	<0.030	0.000
Zinc	mg/L	0.010	0.011	0.001	<0.005	<0.005	0.000

Table 4.7: Comparison of Measured and Predicted Water Quality, Río Uruguay at Marker 100 km along the Border with Argentina

Comparison of water quality as measured in February 2008 at Marker 100 km (Station 12) to the prediction in Table D6.4-2 of the CIS along the Argentina side of the Río Uruguay (Receptor #10) under extreme low flow and monthly maximum effluent loading.							
Parámetros	**Unidades**	**Prediction from CIS**			**Measured by DINAMA**		
		Baseline	**With Mill Discharge**	**Incremental Change**	**Measured at Isla Zapatero**	**Measured at Marker 100 km**	**Difference**
Conventional							
Temperature	°C	-	-	0.0	26.1	25.6	-0.5
TSS	mg/L	5.0	5.1	0.1	<10	<10	0
pH					-	-	-
Conductivity	µS/cm	100	104	4	60	62	1
Color	PtCo	35.0	35.4	0.4	40	50	10
Dissolved oxygen	mg/L	-	-	0	7.4	7.3	0.0
COD	mg/L	15.0	15.6	0.6	-	-	-
BOD	mg/L	0.2	0.2	0.0	<2.2	<2.2	0.0
AOX	mg/L	0.005	0.012	0.007	0.013	<0.009	-0.004
Oil and grease	mg/L	-	-	0.0	-	-	-
Detergentes	mg/L	-	-	0.0	-	-	-
Microbiological							
Fecal coliform	FC/100 mL	-	-	1	6	3	-3
	FC/100 mL				23	20	-3
Esquistosomiasis					-	-	-
Escherichia coli	per/100 mL				10	10	0
Enterococos	per/100 mL				1	2	1
Algae	UPA/ml				<70	<70	0
Nutrients							
Total nitrogen	mg/L	1.10	1.11	0.01	0.93	0.93	0.00
Nitrates	mg/L	0.79	0.79	0.00	0.42	0.42	0.01
Ammonia	mg/L	0.01	0.01	0.00	0.06	0.04	-0.02
Total phosphorus	mg/L	0.200	0.201	0.001	0.04	0.04	0.00
Toxins							
Chlorates	mg/L	-	-	-	-	-	-
Chlorophenols	mg/L	0.003	0.003	0.000	-	-	-
Cyanide	mg/L	-	-	0.000	<0.005	<0.005	0.000
Phenolic substances	mg/L	<0.040	<0.040	0.000	<0.001	<0.001	0.000
Phytosteroles	mg/L	0.022	0.022	0.000	-	-	-
Resin and fatty acids		-	-	-	-	-	-
Sulphide	mg/L	-	-	0.000	-	-	-
Dioxin/Furan	pq/L TEQ	0.460	<0.470	<0.010	-	-	-
2,3,7,8-TCDD	pq/L	<0.500	<0.500	<0.000	-	-	-
Metals							
Arsenic	mg/L	0.0005	0.0009	0.0004	<0.005	<0.005	0.000
Cadmium	mg/L	0.0010	0.0010	0.0000	<0.001	<0.001	0.000
Copper	mg/L	0.01	0.01	0.00	<0.007	<0.003	0.000
Chrome	mg/L	0.003	0.003	0.000	<0.003	<0.003	0.000
Mercury	mg/L	0.0005	-	-	<0.0002	<0.0002	0.0000
Nickel	mg/L	0.003	0.003	0.000	<0.006	<0.020	<0.014
Lead	mg/L	0.023	0.023	0.000	<0.030	<0.030	0.000
Zinc	mg/L	0.015	0.015	0.000	<0.005	<0.005	0.000

Figure 4.1: Water Quality Monitoring Stations along the Río Uruguay

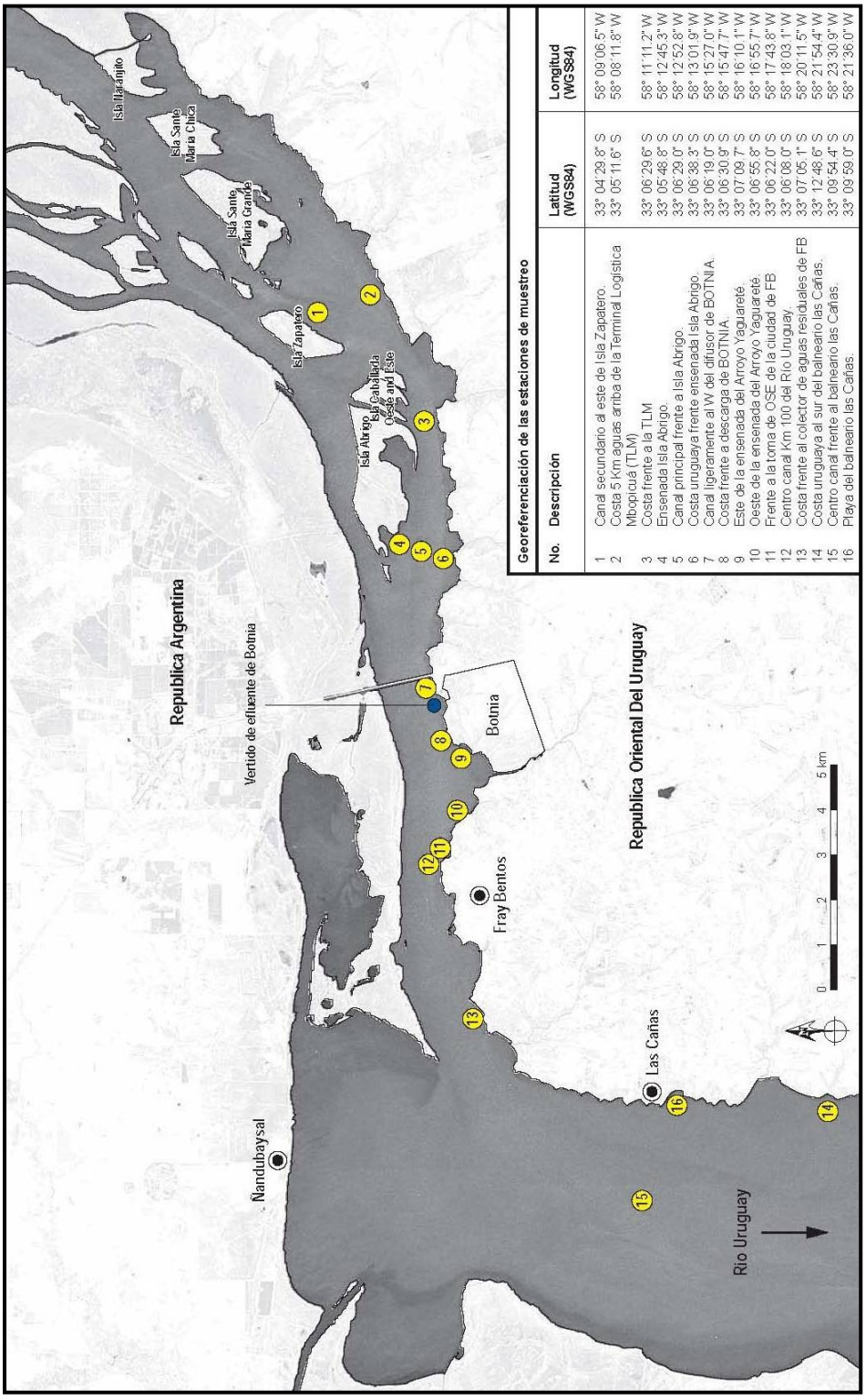
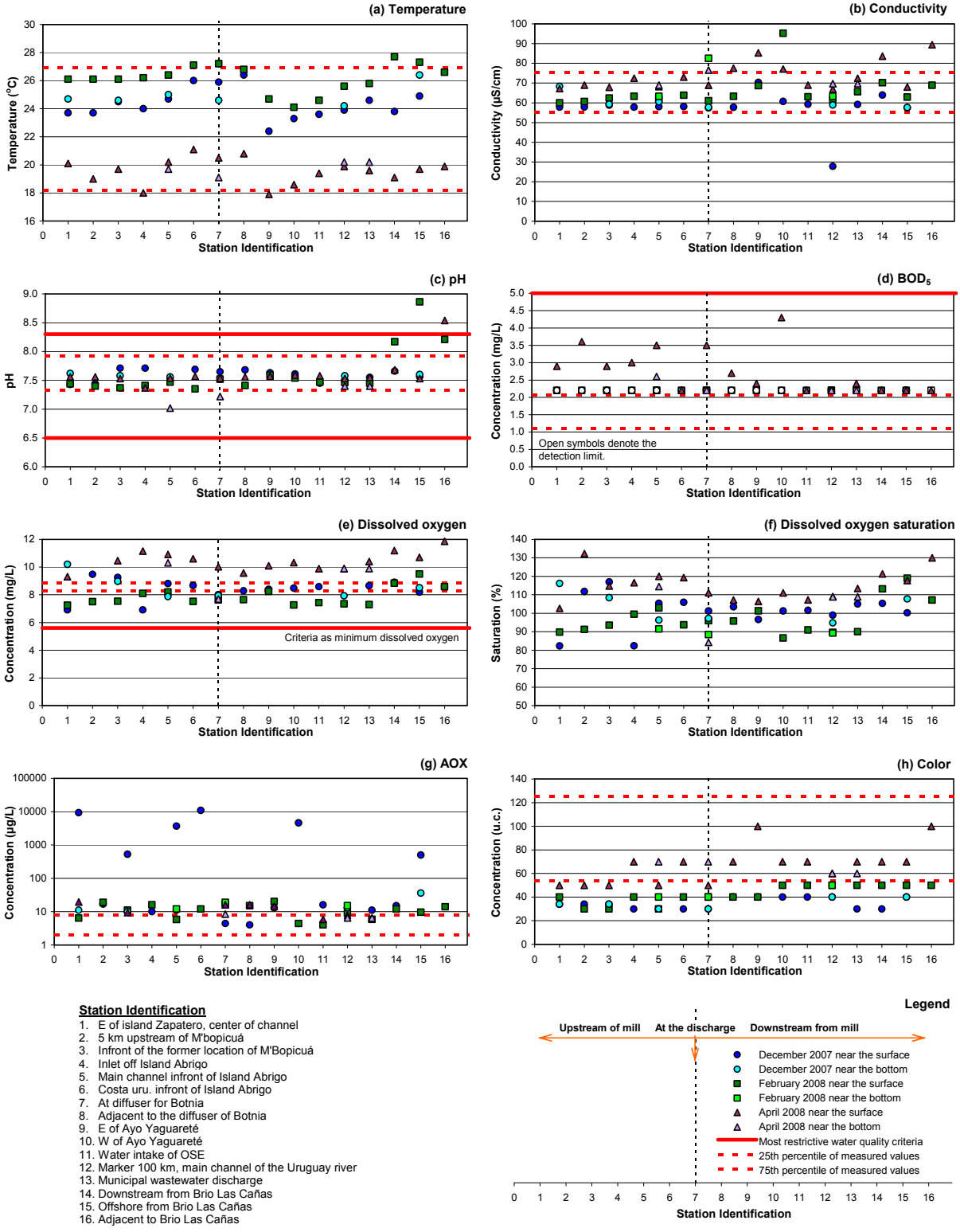


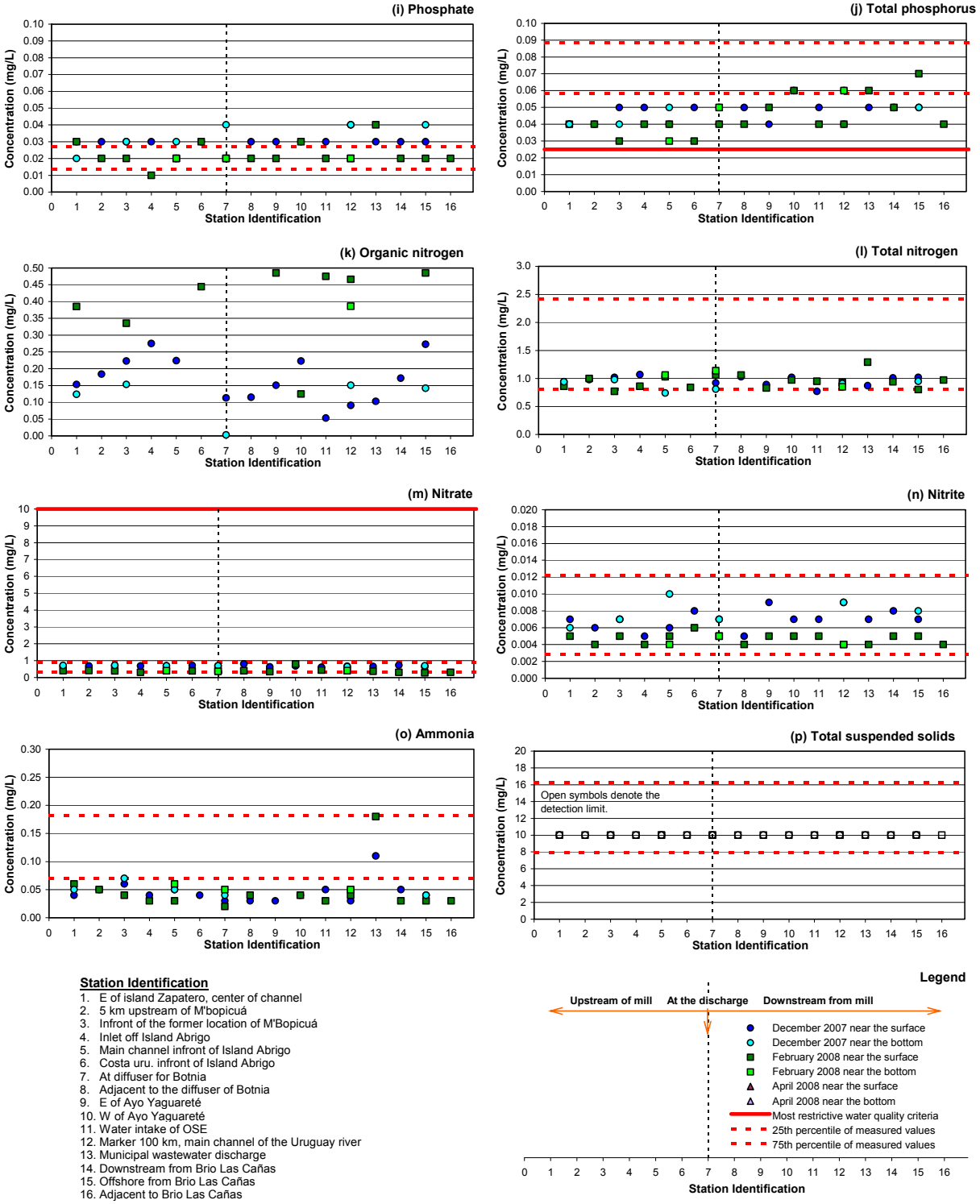
Figure 4.2: Water Quality Monitoring Data, Río Uruguay



Station Identification

1. E of island Zapatero, center of channel
2. 5 km upstream of M'bopicuá
3. Infront of the former location of M'Bopicuá
4. Inlet off Island Abrigo
5. Main channel infront of Island Abrigo
6. Costa uru. infront of Island Abrigo
7. At diffuser for Botnia
8. Adjacent to the diffuser of Botnia
9. E of Ayo Yaguareté
10. W of Ayo Yaguareté
11. Water intake of OSE
12. Marker 100 km, main channel of the Uruguay river
13. Municipal wastewater discharge
14. Downstream from Brio Las Cañas
15. Offshore from Brio Las Cañas
16. Adjacent to Brio Las Cañas

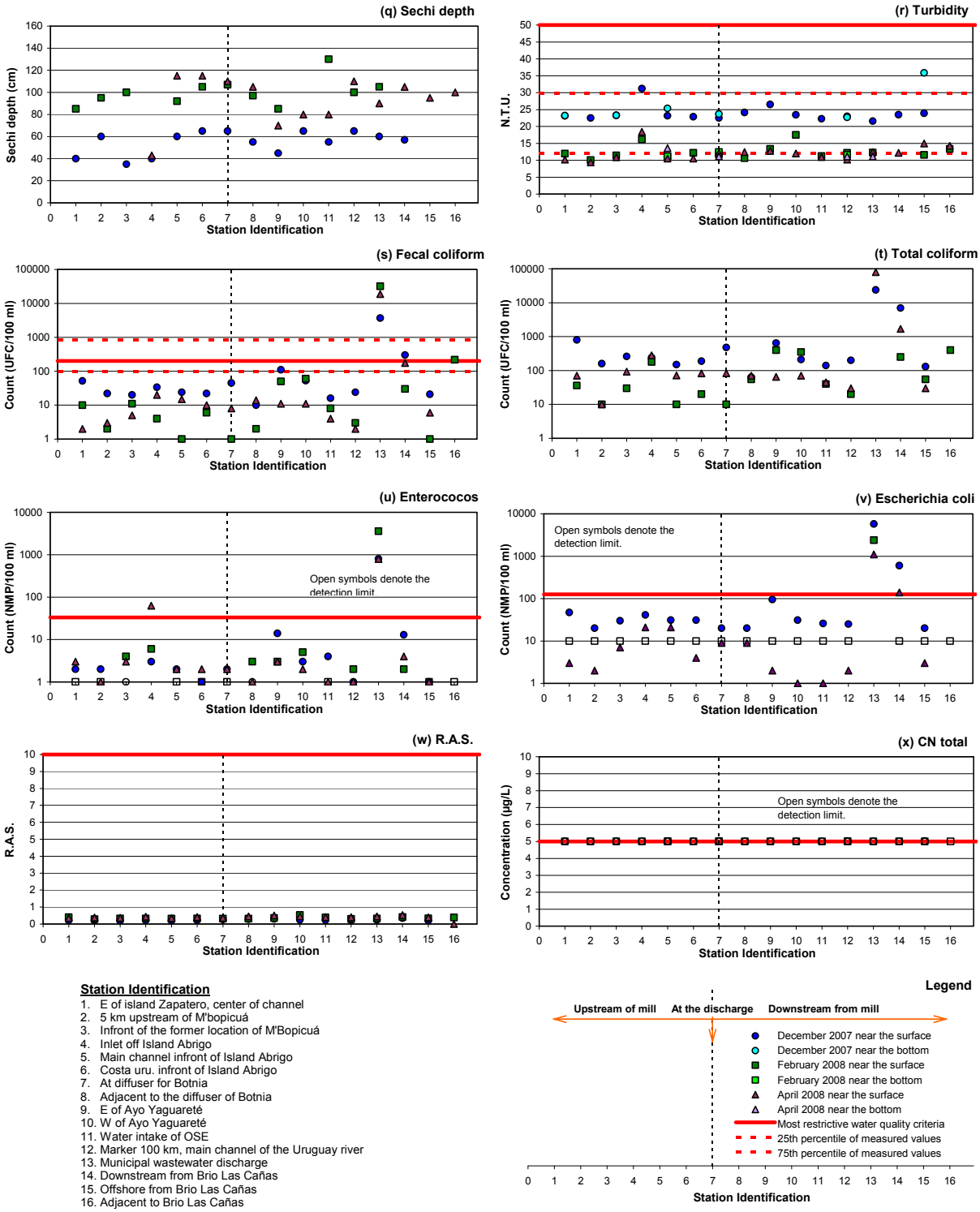
Figure 4.2: Water Quality Monitoring Data, Río Uruguay (continued)



Station Identification

1. E of island Zapatero, center of channel
2. 5 km upstream of M'bopicuá
3. Infront of the former location of M'Bopicuá
4. Inlet off Island Abrigo
5. Main channel infront of Island Abrigo
6. Costa uru. infront of Island Abrigo
7. At diffuser for Botnia
8. Adjacent to the diffuser of Botnia
9. E of Ayo Yaguareté
10. W of Ayo Yaguareté
11. Water intake of OSE
12. Marker 100 km, main channel of the Uruguay river
13. Municipal wastewater discharge
14. Downstream from Brio Las Cañas
15. Offshore from Brio Las Cañas
16. Adjacent to Brio Las Cañas

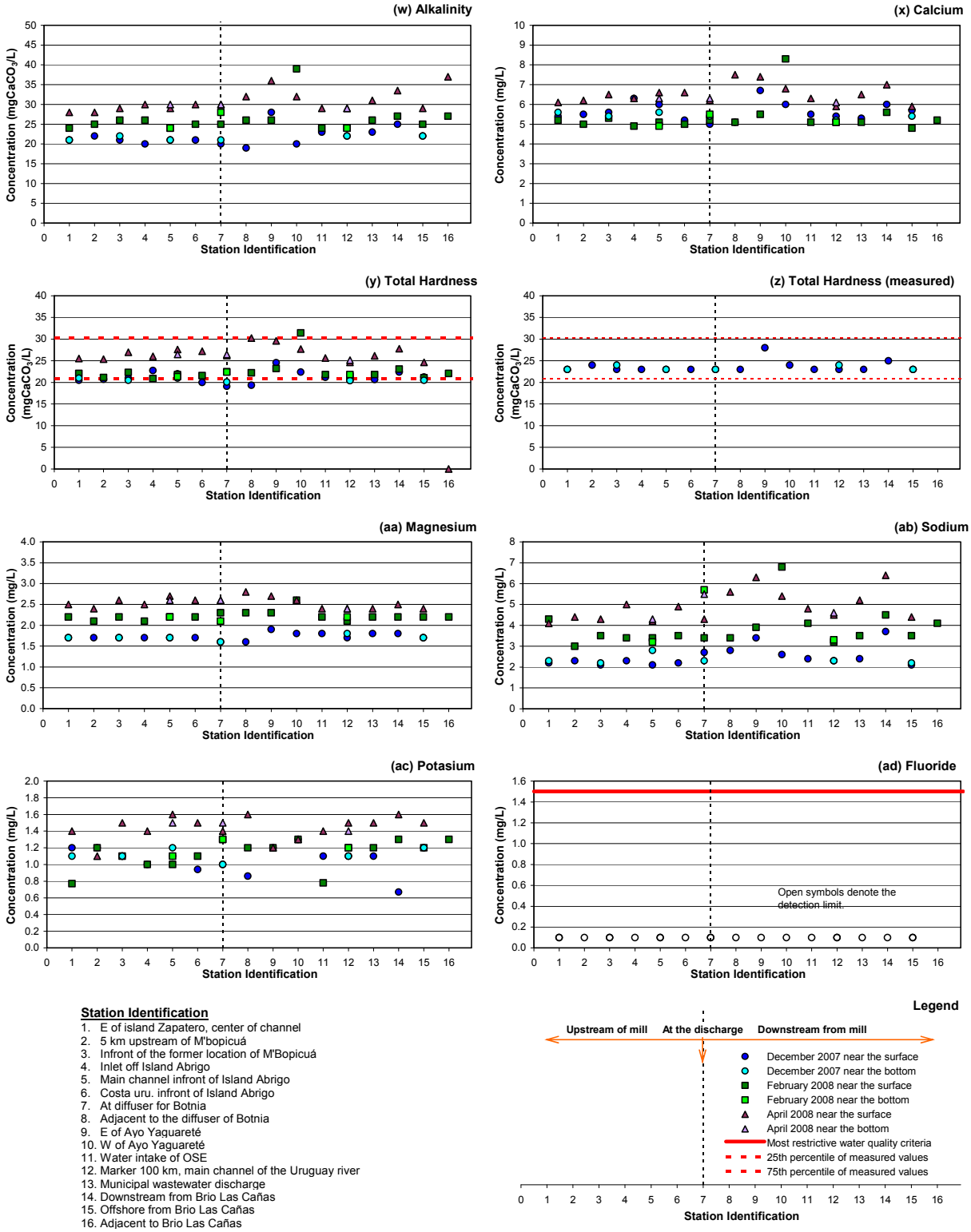
Figure 4.2: Water Quality Monitoring Data, Río Uruguay (continued)



Station Identification

1. E of island Zapatero, center of channel
2. 5 km upstream of M'bopicuá
3. Infront of the former location of M'Bopicuá
4. Inlet off Island Abrigo
5. Main channel infront of Island Abrigo
6. Costa uru. infront of Island Abrigo
7. At diffuser for Botnia
8. Adjacent to the diffuser of Botnia
9. E of Ayo Yaguareté
10. W of Ayo Yaguareté
11. Water intake of OSE
12. Marker 100 km, main channel of the Uruguay river
13. Municipal wastewater discharge
14. Downstream from Brio Las Cañas
15. Offshore from Brio Las Cañas
16. Adjacent to Brio Las Cañas

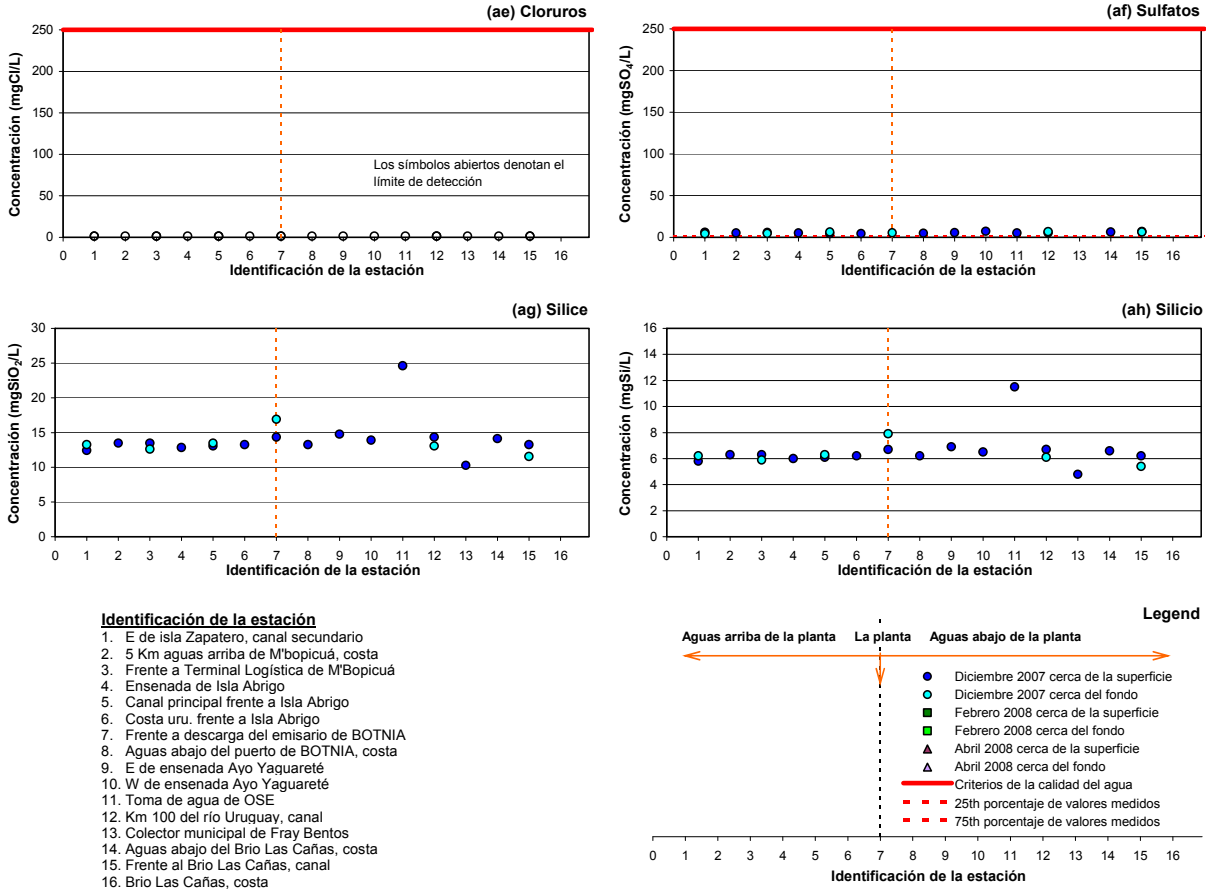
Figure 4.2: Water Quality Monitoring Data, Río Uruguay (continued)



Station Identification

1. E of island Zapatero, center of channel
2. 5 km upstream of M'bopicuá
3. Infront of the former location of M'Bopicuá
4. Inlet off Island Abrigo
5. Main channel infront of Island Abrigo
6. Costa uru. infront of Island Abrigo
7. At diffuser for Botnia
8. Adjacent to the diffuser of Botnia
9. E of Ayo Yaguareté
10. W of Ayo Yaguareté
11. Water intake of OSE
12. Marker 100 km, main channel of the Uruguay river
13. Municipal wastewater discharge
14. Downstream from Brio Las Cañas
15. Offshore from Brio Las Cañas
16. Adjacent to Brio Las Cañas

Figure 4.2: Water Quality Monitoring Data, Río Uruguay (continued)



Identificación de la estación

1. E de isla Zapatero, canal secundario
2. 5 Km aguas arriba de M'bopicuá, costa
3. Frente a Terminal Logística de M'Bopicuá
4. Ensenada de Isla Abrigo
5. Canal principal frente a Isla Abrigo
6. Costa uru. frente a Isla Abrigo
7. Frente a descarga del emisario de BOTNIA
8. Aguas abajo del puerto de BOTNIA, costa
9. E de ensenada Ayo Yaguareté
10. W de ensenada Ayo Yaguareté
11. Toma de agua de OSE
12. Km 100 del río Uruguay, canal
13. Colector municipal de Fray Bentos
14. Aguas abajo del Brio Las Cañas, costa
15. Frente al Brio Las Cañas, canal
16. Brio Las Cañas, costa

5.0 AIR EMISSIONS

5.1 Overview

The air emissions for the Orion mill are routinely monitored as required in the AAP issued by DINAMA. These data are reviewed in the following section to compare the actual air emissions to limits specified by DINAMA in the AAP (Table 5.1) and to the expected loadings predicted in the CIS (Table 5.2). The main findings from this review are summarized in the following points:

- The air emissions from the mill have remained well within the allowable limits specified in the permit issued by DINAMA. The concentrations of total particulate material (TPM), sulphur dioxide (SO_2), nitrogen oxide (NO_x) and total reduced sulphur (TRS) have remained below the respective threshold values within the required 90% frequency.
- The air emissions are well below the expected loads predicted in the CIS for TPM and carbon monoxide (CO), and, other than the first month of operation, for TRS and SO_2. The load for NO_x is comparable to, but has exceeded, the expected maximum value predicted in the CIS. Optimization of the recovery boiler and lime kiln for NO_x often takes one or two years following commissioning based on the experience with other similar modern mills. Air emissions are expected to improve as the production of the mill increases to full capacity and as further optimization measures are implemented during the start-up phase. These anticipated improvements will be reviewed in the one- and two-year monitoring reports.
- The emissions of TRS are generally below the expected emissions predicted in the CIS. The mill has had some releases of malodorous gases although these releases were predicted in the CIS and reported to the community as possibilities prior to the commissioning of the mill.

5.2 Air Emission Quality

The quality of the air emissions from the mill is monitored on a routine basis as per the schedule presented in Table 1.1. The available data are reviewed in the following sections to identify compliance with the air emission limits of DINAMA (Figure 5.1), and to compare with the expected maximum daily load (Figure 5.2) and expected maximum monthly load (Figure 5.3) predicted in the CIS.

The monitoring program for air emissions is comprehensive and provides for a detailed evaluation of the performance of the mill during the first six-months of operation. These data show that the mill is operating within the permissible limits of its operating license and near the expected level of performance. Based on the experience of other modern pulp mills, it is anticipated that performance will improve during the start-up phase as further optimization measures are implemented.

Air emissions are discussed in the following sections for TPM, SO_2, NO_x, TRS and CO.

5.2.1 Particulate Material (TPM)

The threshold concentration for TPM is 150 mg/Nm^3. Since the mill began operation, the concentration of TPM has remained below this threshold value approximately 99.7% of the time (on an annualized basis). This is well below the 10% frequency of exceedance permitted by DINAMA.

The maximum daily loading of TPM was 1,470 kg/d occurring on 27 November 2007 during the first month of operation and during atypical operations caused by a power outage. This loading is well below the expected maximum daily load predicted in the CIS of 2,290 kg/d.

The maximum monthly loading of TPM was 0.14 kg/ADt occurring during the first month of operation. In comparison, the maximum monthly loading expected in the CIS was 0.5 kg/ADt.

5.2.2 Sulphur Dioxide (SO_2)

The concentration of SO_2 has been below the threshold concentration of 500 mg/Nm^3 approximately 97.2% of the time (on an annualized basis), well below the permissible 10% frequency of exceedance.

The maximum daily loading of SO_2 was 7,450 kg/d occurring on 10 November 2007, the first day of operation. This loading is attributed to the burning of fuel oil in the recovery boiler at the time of start-up. This load slightly exceeds (4%) the expected maximum daily load of 7,140 kg/d predicted in the CIS. Beyond the initial start-up, the maximum daily loading was consistently below the expected loading.

The maximum monthly load of SO_2 was 1.06 kg/ADt during the initial month of operation due to the combustion of fuel oil in the recovery boiler during initial start-up. Following initial start-up, the maximum monthly load reduced to the range 0.21 kg/ADt to 0.49 kg/ADt, in comparison to the expected maximum monthly loading of 0.6 kg/ADt predicted in the CIS.

5.2.3 Nitrogen Oxide (NO_x)

The concentration of NO_x has been below the threshold concentration of 300 mg/Nm^3 approximately 96.0% of the time (on an annualized basis), well below the permissible 10% frequency of exceedance.

The maximum daily load of NO_x was 5,750 kg/d occurring on 02 April 2008. This exceeds the expected maximum daily load of 4,570 kg/d predicted in the CIS. The maximum monthly load of NO_x was 2.48 kg/ADt during the initial month of operation. Following initial start-up, the maximum monthly load reduced to the range 1.31 kg/ADt to 1.82 kg/ADt, in comparison to the expected maximum monthly loading of 1.5 kg/ADt predicted in the CIS.

Optimization of the recovery boiler and lime kiln for NO_x often takes one or two years following commissioning based on the experience with other similar modern mills. Over the first six months, optimization efforts prioritized the reduction of TRS and SO_2 since ground level concentrations of NO_x remained low (see Section 6.0). As emissions of TRS and SO_2 continue to reduce, Botnia has indicated that optimization measures will be implemented for NO_x. The loading of NO_x is therefore expected to reduce over the next few months and years as the production increases to full capacity and as further optimization measures are

implemented. These anticipated improvements will be reviewed in the one- and two-year monitoring reports.

5.2.4 Total Reduced Sulphur (TRS)

The concentration of TRS has been below the threshold concentration of 10 mg/Nm^3 from the recovery boiler and 20 mg/Nm^3 from the lime kiln approximately 99.6% and 99.9% of the time (on an annualized basis), respectively. In comparison, the permissible frequency of exceedance is 10%.

The maximum daily load of TRS was 1,180 kg/d occurring on 27 November 2007. The daily load of TRS was also elevated on 03 December 2007 and 27 February 2008 at 216 kg/d and 196 kg/d, respectively. In comparison, the CIS predicted an expected maximum daily load of 860 kg/d from the recovery boiler and lime kiln, and an expected maximum event load of 1,070 kg/event from the concentrated NCG system. The CIS predicted two such events and 14 lesser events during the first year of operation.

The maximum monthly load of TRS was 0.044 kg/ADt during the initial month of operation. Following initial start-up, the maximum monthly load reduced to the range 0.003 kg/ADt to 0.011 kg/ADt, well below the expected maximum monthly loading of 0.1 kg/ADt predicted in the CIS.

5.2.5 Carbon Monoxide (CO)

The mill does not have a permit limit for CO, nor did the CIS provide an estimate of the expected maximum daily load. The CIS did provide an estimate of the expected maximum monthly load of CO at 2.0 kg/ADt. The maximum monthly load of CO recorded during the first six-months of operation was 0.4 kg/ADt, well below the expected value.

Table 5.1: Summary of Air Emissions Concentration Threshold from DINAMA

Parameter	Source of Emission	Instantaneous Concentration	Frequency
• Particulate material (TPM)	All sources	150 mg/Nm^3	Less than 10% of the annual operating time
• Sulphur dioxide (SO_2)	All sources	500 mg/Nm^3	
• Nitrogen oxides (as NO_2)	All sources	300 mg/Nm^3	
• Total reduced sulphur (TRS)	Stack recovery boiler Lime kiln	10 mg/Nm^3 20 mg/Nm^3	

Table 5.2: Estimated Air Emissions for the Botnia Mill from the CIS

Parameter	Monthly maximum (kg/ADt)	24-h maximum (kg/ADt)	24-h maximum (kg/d)[1]
• Carbon monoxide (CO)	2.00	-	-
• Sulphur dioxide (SO_2)	0.60	2.50	7,140
• Nitrogen oxides (as NO_2)	1.50	1.60	4.570
• Particulate material (TPM)	0.50	0.80	2,290
• Inhalable particulate material(PM_{10})	0.45	0.75	2,143
• Total reduced sulphur (TRS)	0.10 -	0.30 -	860[2] 1,070[3]

[1] 24-h maximum load per day is calculated based on a reference production of 1,000,000 ADt/a and 350 operational days per year.
[2] TRS emissions from the recovery boiler and lime kiln.
[3] TRS emissions from the concentrated NCG system, based on a predicted emission rate of 140 g/s for the first 15-minutes of the event and 70 g/s thereafter over a 4-hour event duration. The CIS predicted two 4-hour events, four 15-minute events and ten 15-second events during the first year of operation.

Figure 5.1: Frequency of Exceedance of Concentration Threshold of DINAMA

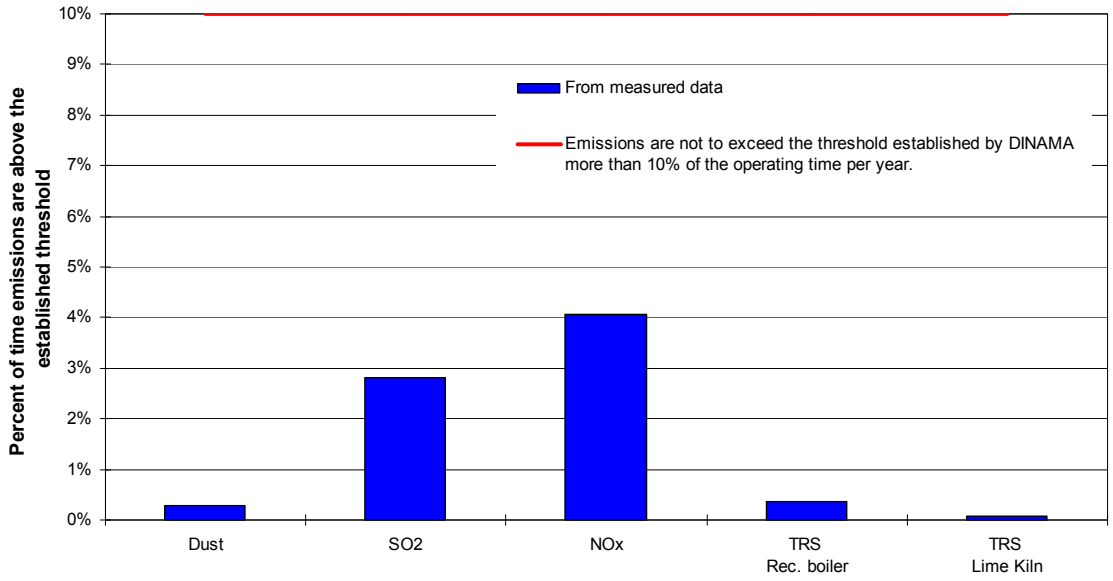


Figure 5.2: Daily Average Air Emission – Load Per Day

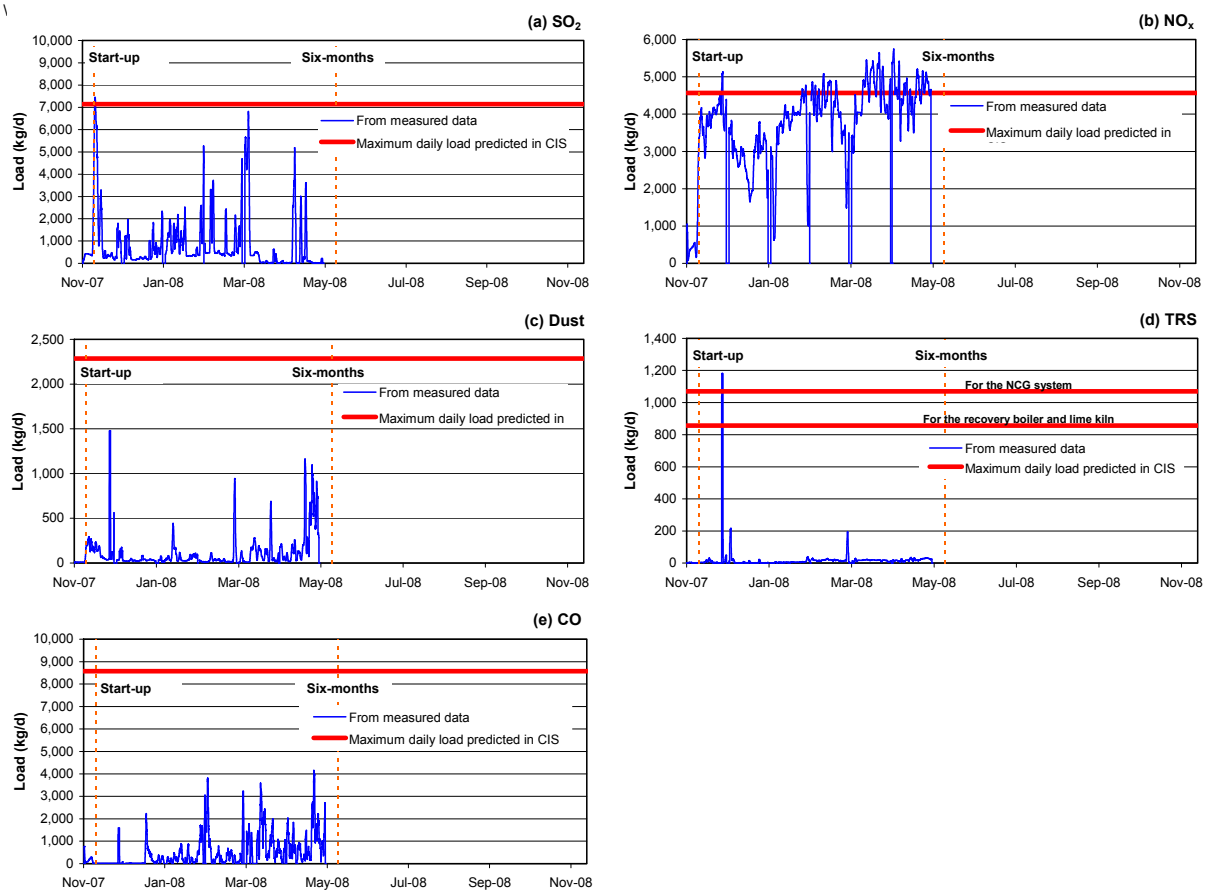
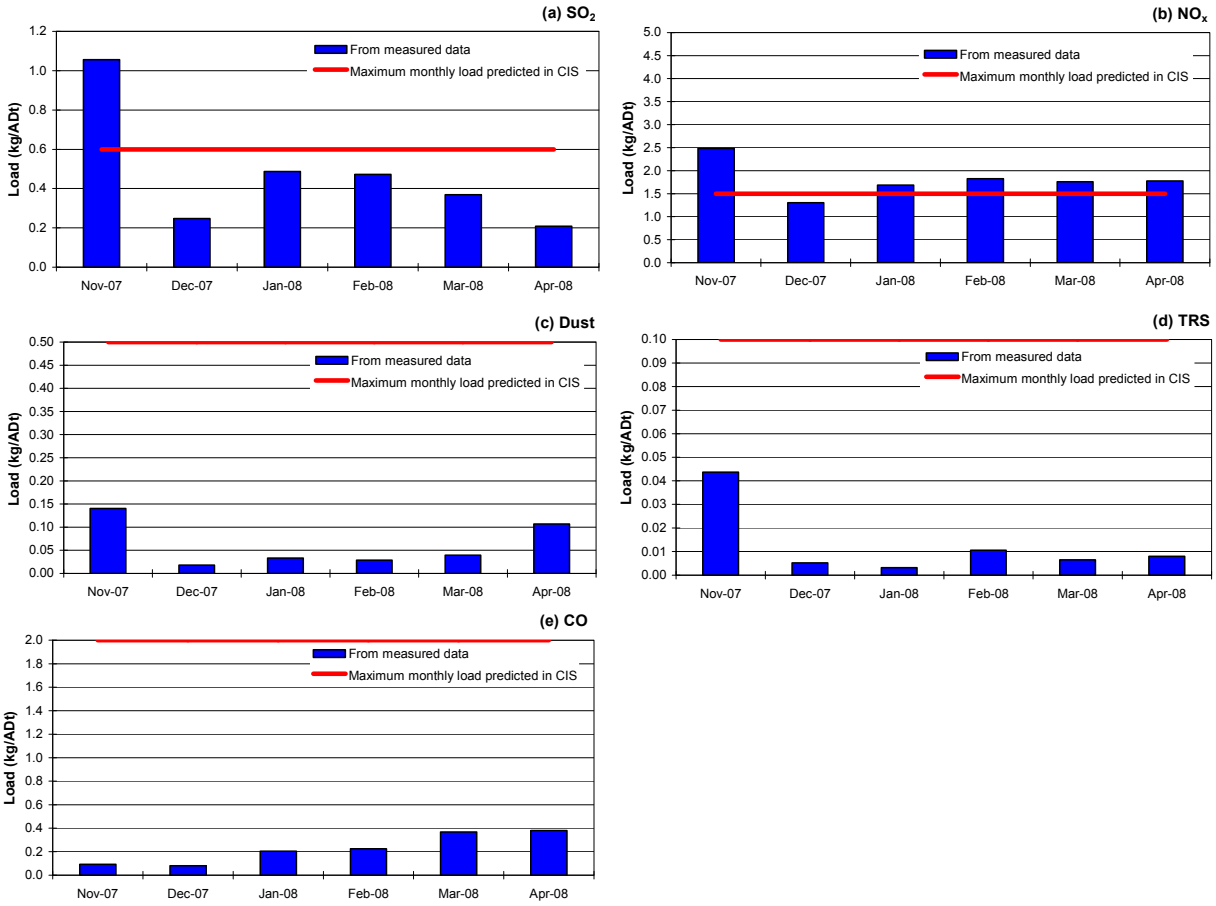


Figure 5.3: Monthly Average Air Emissions – Load per Unit Production



6.0 AMBIENT AIR QUALITY

6.1 Overview

Air quality is measured by LATU at a monitoring station located between Fray Bentos and the mill (Figure 6.1). Parameters routinely monitored include CO, NO_x, SO_2, TRS, PM_{10} and TSP. The available data are presented in Figure 6.2. The start-up date for the mill and six-month operating period are denoted, and the air quality objectives of DINAMA and baseline air quality are shown, where applicable or available, for comparison.

The monitoring data are reviewed in the following sections to assess the potential effect of the mill operations on the ambient air quality. The main conclusions from this review are summarized in the following points:

- The air near the City of Fray Bentos is considered to be of high quality since the concentrations of the indicator parameters CO, NO_x, SO_2, inhalable particulate material (PM_{10}) and total suspended particulate (TSP) are well below the ambient air quality objectives specified by DINAMA in the AAP.
- The air quality objective for TRS was exceeded on three occasions in April 2008 at this monitoring station, although these events are not attributed to the mill since the emissions from the mill were low at the time and well within the CIS projected range for normal operations. It is possible that these exceedances can be attributed to the widespread fires that were burning within the delta of the Río Parana of Argentina during this same period. Satellite images show that the smoke from these fires extended over large areas of Argentina and Uruguay, including the Fray Bentos vicinity (see earth.esa.int/ew/fires/ argentina_fires_apr08/fi_argentina-apr07.htm).
- Objectionable odors were detected by residents of Fray Bentos on 21 November 2007 and on 27 November 2007 during the first month of operation. There have been no complaints of odor from the community since. A newspaper article indicated odors were present in the City of Gualeguaychú, Argentina, during the event on 27 November 2007.
- Mild odors were detected by mill personnel on four occasions between the mill and Fray Bentos. These reported events coincided with recorded short-duration releases of malodorous gases from the mill. Odors were detected on eight other occasions; although, these events do not coincide with recorded releases of malodorous gases from the mill, and on two of these occasions were reported from upwind locations.
- The slight variations in air quality near Fray Bentos between the periods pre- and post-start-up are within the range of natural variability.
- The observations during the first six-months of operation are consistent with the conclusions of the CIS. The ambient air quality has remained well within the levels predicted in the CIS and objectives of the operating permit for the mill, and therefore there it can be stated that there are no risks to human health. Objectionable odors were reported on two occasions and mild odors were reported on at least four other occasions over the first six months of operation. In comparison, the CIS predicted 10 odor events during the first year of operation.

6.2 Comparison to Air Quality Objectives from the AAP

The air quality objectives specified by DINAMA in the AAP are presented in Table 6.1. The air quality criteria used in the CIS (Table 6.2) and air quality standards for other agencies (Table 6.3) are also summarized for comparison.

The air near Fray Bentos is considered to be of high quality based on the available monitoring data. During the six-months of mill operation, the recorded air quality has remained well within the air quality objective, as well as the standards for other agencies listed in Table 6.3, for SO_2, NO_x, CO, TSP and PM_{10}.

The only exception is an exceedance of the air quality objective for TRS on three occasions between 15 to 26 April 2008. These exceedances occurred during a period when the mill was not releasing elevated levels of TRS and therefore they are not attributed to the mill operation. It is possible that the elevated TRS was caused by smoke originating from the widespread fires that were burning within the delta of the Río Parana of Argentina during this same period. Satellite images show that the smoke from these fires extended over large areas of Argentina and Uruguay, including the Fray Bentos area (see earth.esa.int/ew/fires/ argentina_fires_apr08/fi_argentina-apr07.htm).

The only other period of record in which the TRS exceeded the air quality objective was on 18 July 2007, four months prior to start-up of the mill. This exceedance of the TRS objective cannot be attributed to the mill since the mill was not operational at the time. The cause is not known.

Objectionable odors were detected on two occasions by residents of Fray Bentos. Such events were identified as a possibility in the CIS and had been communicated to the public prior to start-up of the mill. Although objectionable from an aesthetic perspective, these short duration events did not present any risk to human health.

The first confirmed event occurred on 21 November 2007 following the accidental release of malodorous gases from the GOS boiler. The event, which lasted for approximately 15-minutes, occurred during testing of the GOS boiler during the initial start-up phase. The incident caused a strong odor that was detected in the City of Fray Bentos. It was considered a significant event since it was the first detection of odor from the mill, and since it caused concern at a local school. Botnia met with school representatives to address their concerns, and issued a press release to explain the incident. (see www.elmostrador.cl/modulos/noticias/constructor/noticia_new.asp?id_noticia=233497).

The second confirmed event occurred on 27 November 2007. As discussed in Section 5.0, TRS was released for approximately 135 minutes from the recovery boiler and GOL boiler under atypical operations caused by a power outage. The conditions causing the event have since been corrected as part of the optimization efforts. Following the release, the 15-minute concentration of TRS peaked at 2.3 $\mu g/m^3$ at the air quality monitoring station, and objectionable odors were detected in the City of Fray Bentos. A newspaper article also reported that odors were detected in the City of Gualeguaychú, Argentina, (see www.espectador.com/1v4_contenido.php?id=110020). TRS does not represent a health concern at the levels recorded, but is a concern from an aesthetic perspective.

Other than these two events (i.e., the events on 21 and 27 November 2007), there are no direct reports or complaints of odor from the community of Fray Bentos.

Mild odors were detected by mill personnel on four occasions between the mill and Fray Bentos. These reported events coincided with recorded short-duration releases of malodorous gases from the mill. Odors were detected on eight other occasions; however, these events do not coincide with recorded releases of malodorous gases from the mill, and in two occasions were reported from upwind locations.

6.3 Comparison to Air Quality Pre- and Post-Start-up

Air quality has been measured near Fray Bentos since June 2006 for CO, NO_x, SO_2, PM_{10}, TSP and TRS. These data are presented in Figure 6.2 and summarized in Figure 6.3. The summary shows the minimum, maximum, average and 95th percentile for the pre- and post-start-up periods. The pre-start-up data are summarized for the full period of available data and for the previous summer period to account for potential seasonal variability. For the post-start-up period, the data are summarized according to the operating condition of the mill. Periods having air emissions similar to or less than the expected emissions based on the CIS are representative of normal operating conditions, and periods exceeding the expected emissions are considered upset conditions.

The slight variations in air quality near Fray Bentos between the periods pre- and post-start-up are within the range of natural variability. The pattern of variability is inconsistent since concentrations have increased for some parameters (e.g., CO and TRS) and decreased for others (e.g., SO_2 and NO_x). These differences are considered significant from a statistical perspective since the large number of observations enable resolution of minor differences. However, these differences are small relative to natural variability, remain well below the respective effects threshold, and therefore do not adversely affect human health or the aesthetic environment.

The average 24-hour concentration of TSP was 22 µg/m^3 during the summer prior to start-up of the mill, and varied from 2 µg/m^3 to 122 µg/m^3. Post start-up, the average 24-hour concentration was 29 µg/m^3 and varied from 5 µg/m^3 to 99 µg/m^3 during normal operating conditions and was 30 µg/m^3 during the upset condition that occurred on 27 November 2007. The change in TSP concentration post-start-up is small relative to natural variability and well below DINAMA's air quality objective of 240 µg/m^3.

The average 24-hour concentration of PM_{10} was 18 µg/m^3 pre-start-up, 22 µg/m^3 post-start-up during normal operating conditions and 20 µg/m^3 post-start-up during upset conditions. In comparison, the PM_{10} concentration varied from 6 µg/m^3 to 49 µg/m^3 during the previous summer and from 0 µg/m^3 to 82 µg/m^3 during the prior winter before mill start-up. The concentration of PM_{10} under conditions pre- and post-start-up are well below DINAMA's air quality objective of 150 µg/m^3, although the upper range of observed concentrations during the prior winter exceed the benchmark of 50 µg/m^3 used in the CIS. The high ambient concentration of PM_{10} during the winter is attributed to domestic heating and is unrelated to the mill since the mill was not operational at the time.

The concentration of SO_2 and NO_x decreased between pre- and post-start-up. The average 24-hour concentration of SO_2 was 3.6 µg/m^3 pre-start-up and 1.5 µg/m^3 post-start-up under normal operating conditions. Similarly, the average 24-hour concentration of NO_x was 6.3 µg/m^3 pre-start-up and 3.2 µg/m^3 post-start-up under normal operating conditions. During upset conditions, the maximum 24-hour concentration of SO_2 and NO_x was 5.0 µg/m^3 and 17.1 µg/m^3, respectively. The concentrations of SO_2 and NO_x during the post-start-up

period are within the range of natural variability observed prior to start-up of the mill, and are well below the respective air quality standards of DINAMA.

The average 24-hour concentration of CO increased from 102 µg/m^3 pre-start-up to 235 µg/m^3 post-start-up. Although statistically significant, this change is within the natural variability ranging from 14 µg/m^3 to 1,105 µg/m^3, and is 140 times below the respective air quality objective.

The average 24-hour concentration of TRS increased from 0.2 µg/m^3 pre-start-up to 0.4 µg/m^3 post-start-up under normal operating conditions. Odor would not be detectable at these low levels. During the upset condition on 27 November 2007, the 15-minute concentration of TRS was 2.3 µg/m^3 at the monitoring station near Fray Bentos. As discussed in Section 6.2, objectionable odors were detected by residents of Fray Bentos and a newspaper article indicated odors were present in the City of Gualeguaychú, Argentina, during the event on 27 November 2007.

6.4 Comparison to CIS Model Predictions

The CIS utilized comprehensive mathematical models to investigate the potential effects of the air emissions on air quality within the surrounding area. These model predictions are presented in Table 6.4. Based on these predictions, the CIS concluded that the mill operations would have minimal effect on ambient air quality. The air quality monitoring data obtained by LATU during the first six-months of mill operation provides preliminary validation of this conclusion.

The CIS concluded that human health and aesthetic environment remained protected since the predicted change in air quality for CO, NO_x, SO_2, PM_{10} and TSP was small relative to the natural variability and since the concentrations remained well below the respective air quality standards. These predictions are validated by the measured air quality data. The ambient air near the City of Fray Bentos remains of high quality irrespective of the operation of the mill.

The CIS identified the potential for infrequent detections of odor near the mill and surrounding area. It estimated the potential for 35 releases of concentrated and diluted NCG and estimated that 10 of these releases may cause detectable levels of odor within the City of Fray Bentos. In comparison, two events caused objectionable odors in the City of Fray Bentos and at least four additional events caused mild odors between the mill and Fray Bentos. Eight other events were reported although these events did not coincide with a release of malodorous gas from the mill and at least two of these events were reported to have occurred upwind from the mill. The one event in the City of Gualeguaychú, Argentina, that was reported in the local newspaper was not predicted by the CIS.

Table 6.1: Summary of Air Quality Objectives of DINAMA from the AAP

Parameter	Unit	Interval	Concentration	Period
• TSP	$\mu g/m^3$	Daily	240	Daily average
• PM_{10}	$\mu g/m^3$	Daily	150	Daily average
• SO_2	$\mu g/m^3$ $\mu g/m^3$	Daily	125 365	95% of the time Not more than once per year
• NO_x	$\mu g/m^3$	Hourly	320	Hourly average
• TRS	$\mu g/m^3$	15-minute	3	2% of time on annual basis
• CO	$\mu g/m^3$	Hourly	30,000	Hourly average

Table 6.2: Summary of Air Quality Criteria used in the CIS

Parameter	Unit	Interval	Concentration	Period
• TSP	$\mu g/m^3$	Daily	120	Daily average
• PM_{10}	$\mu g/m^3$	Daily	50	Daily average
• SO_2	$\mu g/m^3$ $\mu g/m^3$ $\mu g/m^3$	Hourly Daily Annual	690 125 50	Hourly average Daily average Annual average
• NO_x	$\mu g/m^3$ $\mu g/m^3$ $\mu g/m^3$	Hourly Daily Annual	200 200 40	Hourly average Daily average Annual average
• TRS	$\mu g/m^3$ $\mu g/m^3$	Hourly Daily	15 10	Hourly average Daily average

Table 6.3: Summary of Health-Based Ambient Air Quality Standards

Air Contaminant	Averaging Period	California Standards[a] ($\mu g/m^3$)	Ontario Standards[b] ($\mu g/m^3$)	Other Jurisdictions ($\mu g/m^3$)	WHO Guidelines[c] ($\mu g/m^3$)
SO_2	10 minute	-	-	-	500
	1-hour	655	690	-	-
	24-hours	105	275	-	20
	Annual	-	-	-	-
NO_2	1-hour	470	400	-	200
	24-hours	-	200	-	-
	Annual	-	-	-	40
PM (TSP)	24-hour	-	120	-	-
PM_{10}	24-hour	50	50	-	50
	Annual	-	-	-	20
$PM_{2.5}$	24-hour	-	-	-	25
	Annual	-	-	-	10
TRS	30-minute	-	-	40-141	7[d]
	1-hour			7-40	-
	24-hours			3-10	150[d]

[a] California Air Quality Standards (www.arb.ca.gov)
[b] Ontario Regulation 419/05 Standards (www.ene.gov.on.ca)
[c] WHO, Air Quality Guidelines Global update (2005)
[d] WHO, Air Quality Guideline for hydrogen sulfide, (for Europe, 2nd edition, 2000)

Table 6.4: Incremental Effect of Botnia Mill on Air Quality at Fray Bentos, Predicted in the CIS

Parameter	Unit	Interval	Predicted incremental change in air quality from the CIS	
			Under Normal Operation	Under Upset Conditions
• TSP	$\mu g/m^3$ $\mu g/m^3$	Daily Annual	1.0 0.1	2.7 0.2
• PM_{10}	$\mu g/m^3$ $\mu g/m^3$	Daily Annual	0.9 0.1	2.5 0.1
• SO_2	$\mu g/m^3$ $\mu g/m^3$ $\mu g/m^3$	Hourly Daily Annual	8 1.9 0.1	62 14.5 0.9
• NO_x	$\mu g/m^3$ $\mu g/m^3$ $\mu g/m^3$	Hourly Daily Annual	19 5.1 0.3	24 6.7 0.4
• TRS	$\mu g/m^3$ $\mu g/m^3$ $\mu g/m^3$	10-min Hourly Daily	- - -	10 6 1

Figure 6.1: Air Quality Monitoring Station

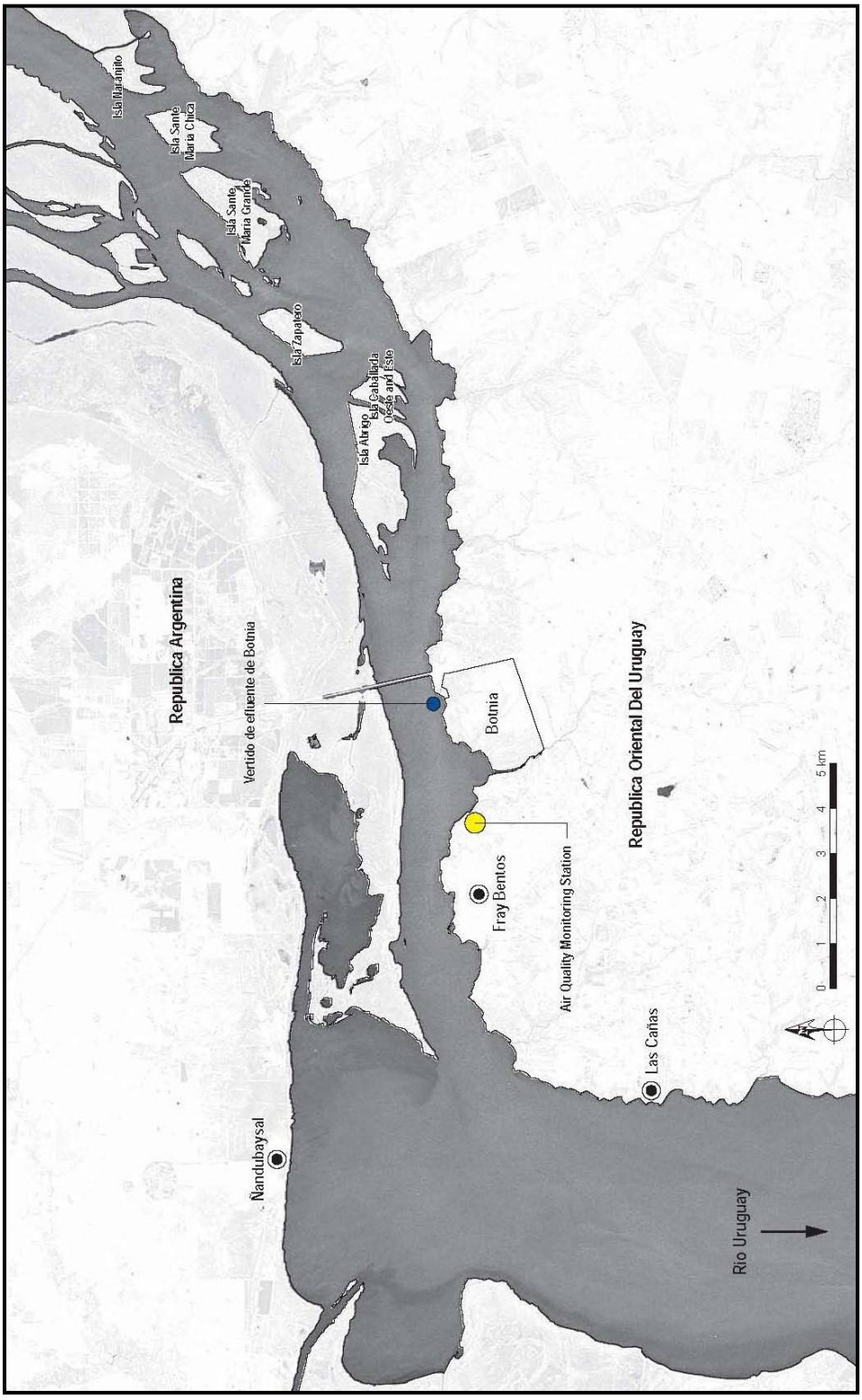


Figure 6.2: Air Quality Monitoring Data, near Fray Bentos

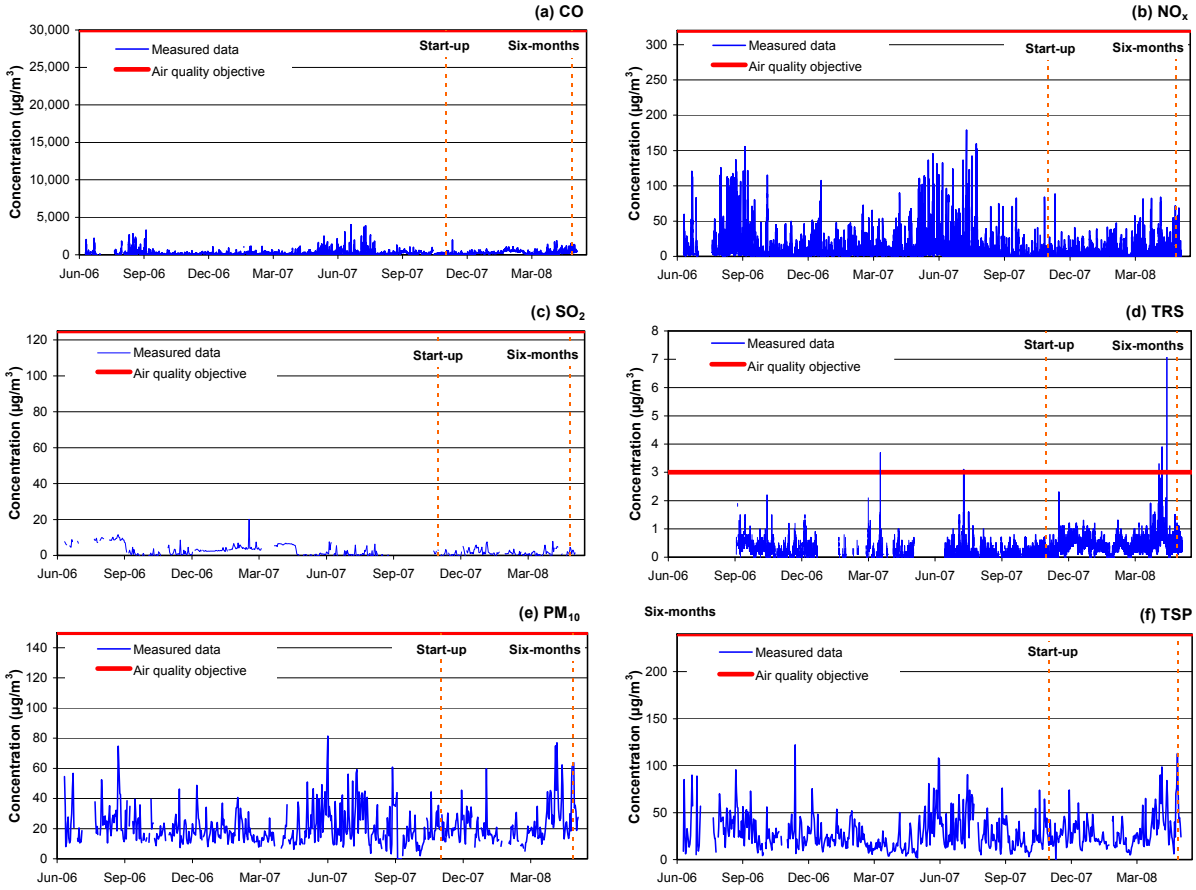
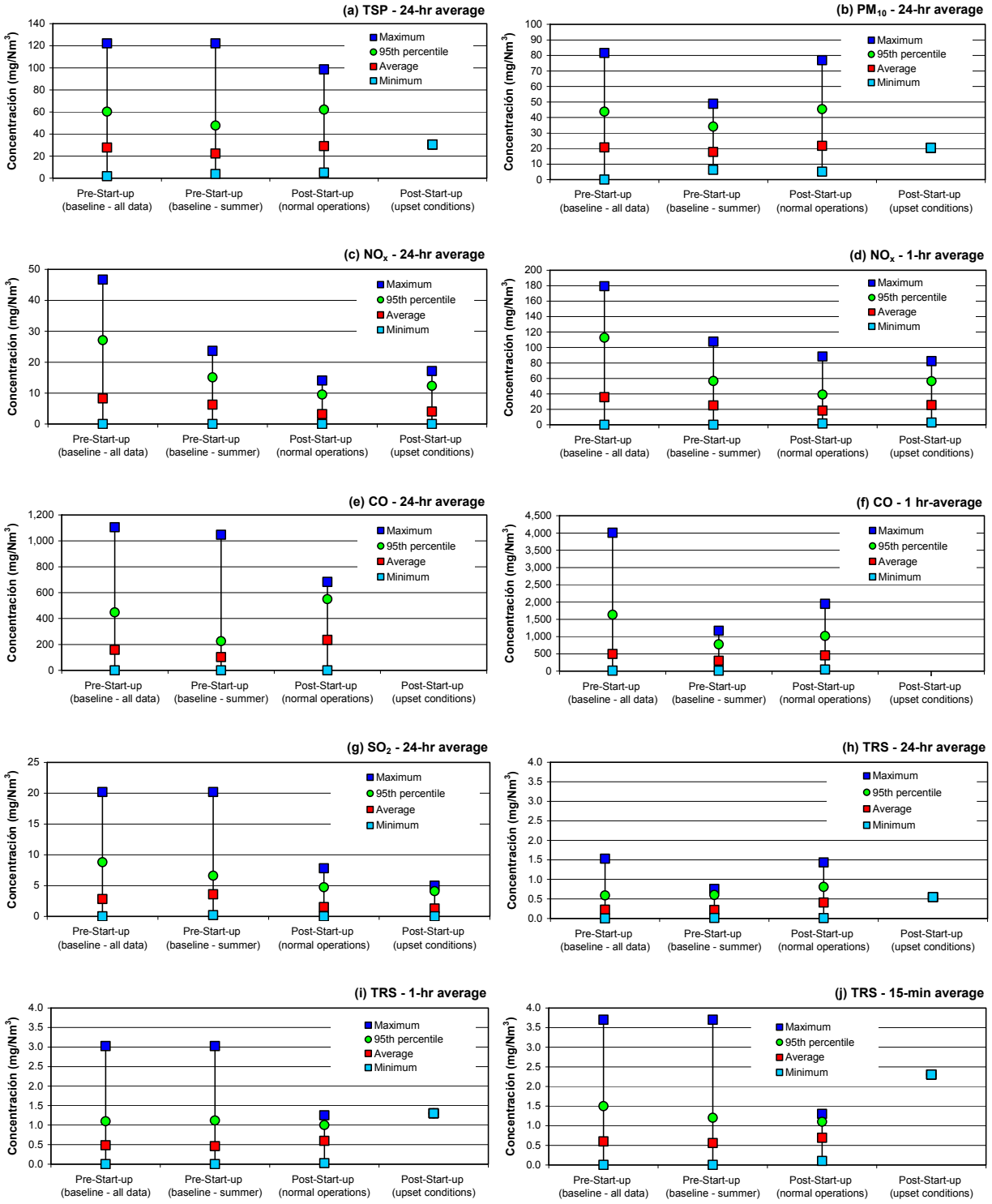


Figure 6.3: Comparison of Air Quality Pre- and Post-Start-up, near Fray Bentos



APPENDIX A

Baseline Water Quality for the Río Uruguay

Table A-1: Water Quality on the Rio Uruguay (CARU Program, 1987-90; CARU, 1993)

Parameter		Salto (Station 40) (n=36)	Paysandu (Station 50) (n=13)	Gualeguaychú (Station 60) (n=26)	Fray Bentos (Station 70) (n=26)
pH	Average	6.9	7.1	7.1	7.4
	Maximum	7.8	7.9	7.8	9.0
	Minimum	5.8	6.5	6.4	6.6
Dissolved oxygen (mg/L)	Average	7.1	7.9	7.5	7.9
	Maximum	10.2	10.1	9.9	10.0
	Minimum	3.1	4.4	3.6	4.5
BOD_5 (mg/L)	Average	3	3	3	4
	Maximum	9	7	9	10
	Minimum	1	1	1	1
Total suspended solids (mg/L)	Average	26	14	12	16
	Maximum	162	29	38	58
	Minimum	3	6	2	2
Total dissolved solids (mg/L)	Average	75	102	106	126
	Maximum	217	158	279	705
	Minimum	21	38	42	29
Alkalinity $CaCO_3$ (mg/L)	Average	24	26	27	28
	Maximum	74	54	70	110
	Minimum	5	2	12	6
Hardness (mg/L)	Average	26	27	29	34
	Maximum	50	42	53	70
	Minimum	9	9	6	13
Conductivity (μS/cm)	Average	65	69	67	71
	Maximum	160	150	160	160
	Minimum	35	40	35	35
Total Kjeldahl nitrogen (mg/L)	Average	0.521	0.590	0.402	0.445
	Maximum	1.37	2.09	0.96	0.93
	Minimum	0.12	0.10	0.01	0.19
Nitrate (mg/L)	Average	0.710	0.586	0.549	0.535
	Maximum	1.400	0.770	0.950	1.870
	Minimum	0.340	0.370	0.001	0.070
Total ammonia (mg/L)	Average	0.080	0.216	0.088	0.077
	Maximum	0.304	1.075	0.542	0.369
	Minimum	0.009	0.023	0.020	0.007
Total phosphorus (mg/L)	Average	0.097	0.093	0.130	0.097
	Maximum	0.310	0.320	0.720	0.240
	Minimum	0.020	0.040	0.010	0.040
Chlorophyll “a”	Average	1.11	1.472	1.37	5.47
	Maximum	11.280	3.300	4.250	55.110
	Minimum	0.050	0.050	0.460	0.050
Fecal coliforms (CFU/100 mL)	Average	500	250	200	100
	Maximum	6,300	12,600	3,200	5,000
	Minimum	15	160	40	10

Table A-2: Historical Record from CARU of Rio Uruguay Water Quality at Points Relevant to the Project (GTAN, 2006)

Location	Station	TSS (mg/L)	n	BOD_5 (mg/L)	n	Dissolved oxygen (mg/L)	n	Dissolved oxygen (% sat.)	n	COD (mg/L)	n	Conductivity (µS/cm)	n	pH (units)	n	N_{total} (mg/L)	n	P_{total} (mg/L)	n	Period of Record
Discharge of Gualeguaychú River[1]	6 GUAY (71)	20.37	40	5.29	35	8.4	40	88.5	14	25.5	42	90.82	39	7.3	40	0.549	43	0.102	39	1987/2005
Main Channel (km 93)	72	12.14	37	4.53	37	8.4	37	89.6	13	25.0	42	67.17	39	7.2	39	0.609	43	0.084	40	1987/2005
Playa La Concordia	81	29.64	14	3.33	12	8.4	14	85.1	4	24.4	12	63.58	12	7.9	11	0.449	11	0.130	10	1987/90-2003/05
Playa La Concordia	82	12.26	13	3.31	14	8.3	13	86.8	4	19.5	15	64.79	15	7.9	14	0.493	15	0.107	15	1987/90-2003/05
Playa La Concordia	83	11.35	9	4.01	14	8.5	9	-	0	20.3	14	78.32	14	7.7	12	0.775	15	0.086	15	1987/1990
Balneario Las Cañas	7 FRAY	8.00	10	4.49	8	8.6	10	81.9	9	16.6	9	62.28	7	7.4	8	0.361	8	0.101	10	1998/2005
Collector Fray Bentos	1 FRAY	14.40	10	4.75	11	8.4	10	83.0	10	26.8	10	83.81	10	7.1	11	0.347	11	0.069	11	1998/2005
1 km above M'Bopicuá	1 BOPI	9.00	5	3.58	3	8.6	5	73.2	5	20.0	3	70.70	5	7.3	5	0.376	4	0.061	4	2003/2005
Zone of emission M'Bopicuá	2 BOPI	10.00	4	3.63	2	8.3	4	65.1	4	20.0	2	66.80	4	7.2	4	0.380	3	0.062	3	2003/2005
1 km below M'Bopicuá	3 BOPI	10.80	5	4.05	3	8.3	5	71.2	5	20.0	3	69.20	4	7.3	5	0.762	4	0.104	4	2003/2005
Water Intake Fray Bentos	4 FRAY	15.20	6	3.90	2	7.9	6	64.0	4	20.0	2	69.65	4	7.0	4	0.325	3	0.123	3	1995-2004-2005
SW Isla Sauzal	3 GUAY	26.67	4	5.00	3	7.9	4	69.1	4	23.3	2	103.53	4	7.4	3	0.373	4	0.077	4	2004/2005
Balneario Ñandubaysal	5 GUAY	18.40	4	3.73	2	8.6	4	63.6	4	20.0	3	66.15	4	6.8	4	0.342	3	0.105	3	2004/2005
		15.25		**4.12**		**8.3**		**76.8**		**21.64**		**73.60**		**7.34**		**0.472**		**0.093**		

[1] In 2005, the Planta Depuradora de Liquidos Cloacales de Gualeguaychú was brought on-line.

Table A-3: Rio Uruguay Water Quality from the Botnia EIA (2004)

	Point 1 – Main Channel Near Fray Bentos Intake		Point 2 – Main Channel in Front of	Point 3 – Main Channel East of International Bridge	Point 6 – Main Channel in Front of Fray Bentos		Point 7 – Las Canas
Parameter	Botnia	OSE	Botnia	Botnia	CARU (Station 70)	CARU (Station 72)	CARU
Date	16 Dec 03	2000-2003	16 Dec 03	16 Dec 03	1987-1990	2003	22 Oct 02
Colour (Pt. Units)	276 (260-295)	61 (24-137)	253 (240-275)	252 (250-255)	n	n	n
Turbidity (NTU)	32 (32-33)	27 (12-52)	32 (31-33)	32 (31-34)	n	n	n
pH	7.2	7.3 (6.7-7.8)	7.2 (7.2-7.3)	7.2	7.4 (6.6-9.0)	7	7.3
Dissolved oxygen (mg/L)	7.19 (7.17-7.20)	7.9 (7.0-8.8)	7.41 (7.4-7.41)	7.55 (7.47-7.60)	7.9 (4.5-10.0)	8.3	7.7
BOD_5 (mg/L)	1.5 (<1-1.5)	n	<1	<1	4 (1-10)	n	<5
Detergents (LAS mg/L)	0.06 (0.05-0.07)	n	<0.05	<0.05	n	n	n
Phenolics (mg/L)	N.D.	n	N.D.	N.D.	n	0.0004	<0.001
Ammonia (mg N-NH_3/L)	0.03 (0.01-0.05)	n	0.04 (0.03-0.04)	0.03 (0.02-0.04)	n	n	n
Nitrites (mg N-NO_2/L)	<0.01	<0.01 (<0.01-0.01)	<0.01	<0.01	0.0028 (0.001-0.007)	n	0.007
Phosphorus (mg P/L)	0.03 (0.02-0.03)	n	0.05 (0.04-0.06)	0.03 (0.02-0.05)	0.1	n	0.05
Fecal coliforms (CFU/100 mL)	N	310 (200-691)	n	n	100 (10-5,000)	n	270
Arsenic (mg/L)	<0.010	n	<0.010	<0.010	n	n	N
Cadmium (mg/L)	<0.010	n	<0.010	<0.010	0.00015 (0.0001-0.0002)	n	<0.00001
Copper (mg/L)	0.018 (0.015-0.025)	n	0.056 (0.050-0.069)	0.044 (0.027-0.065)	0.0105 (0.009-0.012)	n	0.00438
Chromium (mg/L)	0.08 (0.07-0.11)	n	0.06 (0.05-0.07)	0.04 (0.03-0.05)	0.004 (0.002-0.009)	0.001	0.002
Mercury (mg/L)	<0.0005	n	<0.0005	<0.0005	n	n	n
Nickel (mg/L)	<0.020	n	0.050 (0.030-0.067)	<0.020	n	n	0.0056
Lead (mg/L)	<0.010	n	<0.010	<0.010	n	n	0.00373
Zinc (mg/L)	<0.010	n	0.061 (0.059-0.063)	0.107 (0.042-0.169)	0.018 (0.002-0.035)	n	0.029

Table A-3: Rio Uruguay Water Quality from the Botnia EIA (2004) (cont'd)

	Point 1 – Main Channel Near Fray Bentos Intake		Point 2 – Main Channel in Front of	Point 3 – Main Channel East of International Bridge	Point 6 – Main Channel in Front of Fray Bentos		Point 7 – Las Canas
Parameter	Botnia	OSE	Botnia	Botnia	CARU (Station 70)	CARU (Station 72)	CARU
Temperature (°C)	24.1 (24.1-24.2)	22.5	24	23.9 (23.9-24)	n	18	19.4
% Oxygen saturation	85.6 (85.5-85.7)	n	87.9 (87.8-88.1)	89.5 (88.5-90.4)	n	n	83
Conductivity (μS/cm)	42 (40-45)	55 (34-73)	43 (40-45)	42 (40-45)	71 (35-160)	62	60
Total hardness ($CaCO_3$ mg/L)	N	33.8 (30-42)	n	n	34 (13-70)	n	26
Alkalinity ($CaCO_3$ mg/L)	N	34 (22-52)	n	n	28 (6-110)	29	24.1
Total nitrogen (mg N/L)	<2	n	<2	<2	0.445 (0.19-0.93)	n	0.52
Nitrate (mg N-NO_3/L)	1.1	<11 (<11)	1.1 (1.0-1.2)	1.2 (1.1-1.3)	0.549 (0.001-0.950)	n	0.36
Phosphorus (mg P-PO_4/L)	0.08 (0.06-0.09)	n	0.08 (0.09-0.12)	0.07 (0.06-0.09)	0.044 (0.005-0.139)	n	0.02
Ammonia (NH_4 mg/L)	N	0.09 (<0.04-0.42)	n	n	0.077 (0.007-0.369)	n	0.05
COD (mg/L)	<1	n	1	2	n	n	<40
Sulphate (mg SO_4/L)	4.5 (4.0-4.8)	n	4.7 (4.0-5.0)	4.4 (3.9-4.7)	20 (3-80)	2	3.75
Chloride (Cl mg/L)	2.2 (1.9-2.4)	3.63 (1.9-6.4)	2.1 (2.0-2.2)	2.0 (1.9-2.2)	2.8 (0.0-7.0)	2	1.8
Iron (mg/L)	2.29 (2.20-2.39)	1.3 (1.0-1.7)	2.38 (2.20-2.52)	2.18 (2.00-2.30)	0.12	n	0.67
Manganese (mg/L)	<0.010	n	0.054 (0.048-0.057)	0.036 (0.030-0.046)	0.038 (0.030-0.045)	n	0.0598
Fluoride (mg/L)	n	n	n	n	n	n	n
Selenium (mg/L)	n	n	n	n	n	n	n
AOX (mg/L)	0.0075	n	>0.002 detec. lim. <0.006 quant. lim.	-	n	n	n

N.D. – not detectable.
n – not analyzed.

Table A-4: Water Quality Observations by Botnia at Four Rio Uruguay Locations in 2005/06

		Nuevo Berlín Date of Sampling							Bridge							Botnia							Las Cañas						
Parameter	Units	04-May	06-May	08-May	10-May	12-May	01-Jun	03-Jun	04-May	06-May	08-May	10-May	12-May	01-Jun	03-Jun	04-May	06-May	08-May	10-May	12-May	01-Jun	03-Jun	04-May	06-May	08-May	10-May	12-May	01-Jun	03-Jun
Temperature	°C	18.2	18.2	15.6	22.3	26.8	27.9	24.6	18.2	18.2	15.8	22.4	27.4	28.5	24.4	18	18.4	15.8	21.9	27.3	29.7	24.4	18	18.1	15.7	23.2	27.4	29.8	23.9
Conductivity	µS/cm	109	54.7	81	51	66.2	84.5	71.3	69	51.6	79.9	52	57.7	74.3	66.1	73	53.9	103.4	55	55.3	69.6	69.8	75	55.9	101.3	55	56.4	76	74.5
Colour	Pt-Co	ND[1]	125	75	125	55	55	30	ND	125	75	125	55	55	35	ND	125	75	125	50	55	35	ND	125	75	125	50	55	30
DO	mg/L	8.31	8.71	9.32	8.18	8.22	8.61	8.58	8.14	8.46	9.27	8.13	8.3	9.23	8.55	8.36	8.34	9.16	8.03	8.27	9.15	8.54	8.45	8.05	9.54	8.36	8.26	9.55	8.74
pH	-	7.8	7.04	7.4	7.14	7.92	8.32	7.67	7.7	7.05	7.49	7.24	8	8.8	7.75	7.8	7.2	7.58	7.14	8.03	8.98	7.73	7.8	6.96	7.58	7.35	7.72	9.19	7.94
Turbidity	NTU	36.9	23	21	35	9	12	11	27	59	20	32	9.3	11	15	19.2	35	17	28	9.4	12	13	20.1	49	29	23	8.5	16	39
TDS	mg/L	43	77	43.5	64.5	37	54	73.5	66	84.5	42.5	49.5	30	41.5	65.5	45	90	91	55	42	35	73	65	86.2	115	54.5	61	29.5	66.5
TSS	mg/L	12	28.5	7.2	13.8	<5	10.8	<5	16	32.5	6.2	8.8	<5	13.4	8.2	8	16	<5	6	<5	7.8	7.2	<5	24	17	<5	<5	11	60.3
Hardness	mg/L	26.6	20.7	30.5	20	22	30.2	25	27.4	20.2	32.2	20.3	20.8	24.4	24.2	28	23.7	44.2	20.8	20.3	23.7	23.4	30.2	22.7	45.8	20.6	34.4	22.4	35
Chloride	mg/L	2	1.98	2.15	2.99	2.56	1.96	1.53	2.7	1.36	1.8	1.75	1.59	4.38	1.49	1.3	1.56	3.31	2.45	1.62	2.47	1.61	1.6	1.75	2.11	2.17	2.48	2.73	1.73
Sulphate	mg/L	1.3	1.36	1.32	1.44	2.17	3.04	1.28	1.2	1.31	1.23	1.23	1.95	6.83	1.28	1.4	0.92	1.68	0.94	2.01	3.1	1.44	1.5	1.52	1.54	1.09	2.56	3.54	1.76
Nitrate	mg/L	4.5	0.87	0.56	0.44	0.39	0.17	0.23	2.4	0.93	0.58	0.71	0.37	0.55	0.21	5.9	0.9	0.58	0.46	0.36	0.16	0.24	2.3	0.95	0.66	0.5	0.38	0.04	0.16
Nitrite	µg/L	2.7	3.6	12.2	ND	<5	8.8	44.8	3.5	2.4	12.2	ND	<5	<5	40	2.7	1.9	7.7	ND	18.1	<5	31.3	3.2	2.8	8.2	ND	<5	<5	2.9
TKN	mg/L	2.4	0.6	0.01	0.8	1.1	1.2	0.23	1.5	0.8	0.45	0.42	0.37	1.3	0.2	1.5	0.8	0.04	0.48	1.5	1.3	0.47	2.4	0.9	0.47	0.26	1.8	1.6	0.36
Ammonia	mg/L	0.19	ND	0.069	ND	0.12	<DL[2]	0.07	0.54	ND	ND	ND	0.15	<DL	0.06	0.16	ND	ND	ND	0.13	<DL	0.06	0.34	ND	0.06	ND	0.21	<DL	0.07
TP	µg/L	73.7	88	49	86.2	26.7	115	68.9	77.8	105	58.8	91.3	29.3	109	90.1	57	74.4	88	81	31.9	75.8	114	43.9	84.7	81.6	83.6	26.7	81	94.8
SRP	µg/L	26.6	8	15	9.5	23.7	54.2	46.9	27.7	9	7.3	18.5	14.6	31.2	42.1	24.8	12.2	14	15.9	6.9	19.8	39.8	27.2	5.5	19	19.8	19.8	24.2	68.2
Arsenic	mg/L	ND	<DL	<DL	<DL	<DL	<DL	<DL[1]	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL
Cadmium	mg/L	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL
Copper	mg/L	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL
Zinc	mg/L	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL
Chromium	mg/L	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL
Iron	mg/L	ND	4.2	2.2	1.8	0.9	1.2	0.74	ND	4.5	1.4	2.3	1	0.69	0.53	ND	3.9	1.8	1.6	1.2	1.2	0.59	ND	3.5	2.9	1.7	1.5	0.69	0.46
Magnesium	mg/L	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL
Mercury	mg/L	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL
Nickel	mg/L	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL
Lead	mg/L	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL	ND	<DL	<DL	<DL	<DL	<DL	<DL
COD	mg/L	ND	<11	<11	<11	<11	<11	<11	ND	<11	<11	<11	<11	<11	<11	ND	<11	<11	<11	<11	<11	<11	ND	<11	<11	<11	<11	<11	<11
BOD_7	mg/L	4.8	1.4	1.3	1	1.1	1.9	0.8	4.4	1.8	1.1	2.3	0.8	1.5	0.7	4.8	1.3	1.2	2.3	1.2	2	0.6	2.8	1.4	1.2	1.5	1	2.4	1.2
AOX	µg/L	ND	7	ND	ND	8	ND	7	ND	7	ND	ND	8	ND	7	<2	8	12	ND	7	ND	<DL	ND	8	9	ND	11	ND	8
Phenolics	µg/L	ND	<1	<1	<1	<1	5.7	<1	ND	<1	<1	<1	<1	ND	<1	ND	<1	<1	<1	<1	ND	<1	ND	1.2	<1	<1	<1	ND	<1
Coliforms[3]	MPN/ 100 mL	ND	232	2600	312	130	19.6	62	ND	256	3280	460	58	19.4	54	ND	230	804	196	31.4	266	108	ND	940	1960	1340	640	276	1980

[1] No determination of this parameter on this date.
[2] Below analytical detection limit.
[3] Total fecal coliforms, average of five replicate samples per day per site.

Table A-5: Water Quality on the Rio Uruguay from the ENCE EIA (2002)

Parameter (units)	Point 1 – Above Discharge	Point 2 – Yaguareté Bay – Playa Ubici	Fray Bentos Water Intake	Fray Bentos Municipal Discharge	Beach near Arroyo Fray Bentos	Las Cañas Water Intake	Beach near Arroyo Las Cañas
Alkalinity (mg/L $CaCO_3$)	32	35.5	32	33	32.5	30	31.5
Ammonia (mg/L N-NH_3)	0.175	0.16	0.13	0.155	0.155	0.195	0.09
Arsenic (mg/L As)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chloride (mg/L Cl)	4.2	4.15	4.1	2.1	5.15	5.65	4.1
Copper (mg/L Cu)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
True colour (Pt-Co)	125	125	125	125	125	125	125
Total chromium (mg/L Cr)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
BOD_5 (mg/L)	3	4	3.5	3.5	4	4	4
Detergents (mg/L SAAM)	0.4	0.425	0.285	0.365	0.41	0.24	0.9
Total hardness (mg/L $CaCO_3$)	19.8	21.7	18.1	19.55	19.7	19.85	19.8
Fluoride (mg/L F)	0.12	0.13	0.115	0.12	0.11	0.11	0.11
Iron (mg/L Fe)	3.74	2.89	4.24	3.795	3.525	3.385	3.3
Manganese (mg/L Mn)	0.04	0.02	0.04	0.035	0.03	0.02	0.025
Nickel (mg/L Ni)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Nitrate (mg/L N-NO_3^-)	0.81	0.78	0.845	0.845	0.85	0.855	0.9
Dissolved oxygen (mg/L)	8.5	8.7	8.7	8.1	8.1	8.25	8.4
pH	7	7.345	7.17	7.12	7.105	7.03	6.6
Lead (mg/L Pb)	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Selenium (mg/L Se)	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Temperature (°C)	19.9	19.15	18.9	19.05	19.4	19.95	19.4
Zinc (mg/L Zn)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fecal coliforms (NMP/100 mL)	42.5	170	50.5	9,100	7,400	720	950
AOX (μg/L)	NQ	ND	ND	ND	-	-	-

NQ = Not Quantifiable
ND = Not Detectable

Table A-6: Water Quality on the Rio Uruguay (Algoritmos, 2006)

Parameter	Sampling Locations[1]									
	1	M	2	3	B	4	5	6	7	8
BOD_5 (mg/L)	0.7	0.5	1.8	0.2	0.2	0.1	0.2	0.5	0.1	0.2
COD (mg/L)	<5	<5	14	15	6	<5	<5	<5	24	6
N total (mg/L)	<0.04	<0.04	0.68	1.10	1.02	0.95	0.35	0.97	0.85	0.74
P (mg/L)	0.14	0.14	0.21	0.20	0.15	0.22	0.13	0.14	0.10	0.15
NO_3^- (mg/L)	0.63	0.63	0.54	0.79	0.63	0.36	0.59	0.61	0.38	0.61
Ammonia (mg/L)	<0.01	<0.01	<0.01	<0.01	<0.01	0.10	<0.01	0.26	<0.01	0.23
SST (mg/L)	4	11	12	5	8	14	8	8	41	10
C_6H_5OH (μg/L)	<40	<40	<40	<40	<40	<40	<40	<40	<40	<40
ClO_3^- (μg/L)	<20	<20	<20	40	30	<20	<20	<20	<20	<20
As (μg/L)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cu (μg/L)	11	10	10	8	12	8	6	7	8	8
Fe (μg/L)	1,400	1,500	1,600	1,880	1,800	2,070	1,730	1,670	2,000	1,640
Cr (μg/L)	3	3	3	3	3	3	2	3	3	2
Hg (μg/L)	0.4	0.6	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.6
Ni (μg/L)	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Pb (μg/L)	39	16	17	23	24	<5	<5	<5	<5	<5
Zn (μg/L)	18	84	22	15	15	11	8	10	15	12
Cd (μg/L)	2	1	1	1	1	<0.5	<0.5	<0.5	<0.5	<0.5
Chlorophenols (μg/L)[2]	1.0	8.3	11.6	3.4	1.4	1.4	2.9	<1.0	11.9	4.9
AOX (mg/L)	0.003	<0.001	<0.001	0.005	0.004	0.004	0.003	0.0068	0.002	<0.001

[1] Identification of sampling locations:
- 1: Near Arroyo M'Bopicuá
- M: 50 m below ENCE discharge
- 2: Puerto Unzué
- 3: International Bridge
- B: 50 m above Botnia discharge
- 4: Near Arroyo Yaguareté
- 5: Playa Ubici Nearshore
- 6: Fray Bentos Water Intake
- 7: Balneario Ñandubaysal Nearshore
- 8: Balneario Las Cañas Nearshore

[2] Chlorophenols shown as a sum of compounds with values above detection limits.

Table A-7: Baseline Concentrations of AOX, Chlorophenols, Resin and Fatty Acids, Phytosterols, and Dioxins and Furans in Rio Uruguay Water (Tana, 2005, 2006)

Location	AOX (μg/L)	Chlorophenols (ng/L)	Resin Acids (μg/L)	Fatty Acids (μg/L)	Phytosterols[2] (μg/L)	Dioxins/Furans[1] (pg/L)	
						Sum	I-TEQ
April 2005							
Nuevo Berlin	11	94	163	786	ND	1.04	0.46
Yaguareté Bay	12	114	183	738	ND	ND	ND
Las Cañas	12	106	202	742	ND	ND	ND
December 2005							
Nuevo Berlin	10	89	224	231	22	ND	ND
Yaguareté Bay	6	80	35	172	ND	ND	ND
Las Cañas	<5	89	53	145	ND	49.8	0.31

[1] Detection limits 0.2 to 2 pg/L.
[2] Detection limits 1 to 3 μg/L.

Table A-8: Nutrient Water Quality on the Rio Uruguay (CELA, 2005, 2006)

Location	Secchi (m)	pH (-)	DO (mg/L)	Temp. (°C)	Conductivity (µS/cm)	NH_4 (µg/L)	NO_2 (µg/L)	NO_3 (µg/L)	DIN (µg/L)	N_{total} (µg/L)	PO_4 (µg/L)	P_{total} (µg/L)
April 2005												
NB 2	0.5	6.7	-	-	70.1	15.8	3.8	204.7	224.3	485.7	16.9	49.5
NB 3	0.5	7.1	-	-	73.4	38.1	4.5	171.0	213.6	509.3	21.7	95.7
FB 1	0.5	7.2	-	-	83.4	21.1	4.8	168.6	194.5	599.7	22.2	84.3
FB 2	0.5	7.1	-	-	72.2	25.0	4.8	177.2	207.1	587.2	20.5	70.4
FB 3	0.5	7.1	-	-	76.9	42.3	3.7	184.5	230.4	694.5	38.6	82.3
LC 1	0.6	7.2	-	-	75.7	27.6	4.7	163.9	196.2	534.5	31.4	71.0
LC 2	0.5	7.0	-	-	69.5	22.0	4.2	182.8	209.0	522.5	25.5	62.5
LC 3	0.4	7.0	-	-	69.1	26.6	4.6	190.1	221.2	623.4	29.0	66.3
January 2006												
NB 1	3.7	0.8	0.0	0.4	2.6	18.3	17.5	15.4	13.0	6.0	-	2.4
NB 2	3.5	0.7	0.0	0.2	0.3	11.5	15.5	6.8	6.7	10.6	-	15.5
NB 3	0.0	0.5	1.5	0.2	0.4	2.4	17.1	15.0	13.6	20.3	-	13.1
FB 1	0.0	0.4	0.8	0.2	5.4	22.7	8.0	1.6	6.1	10.2	-	15.5
FB 2	3.9	1.2	4.3	0.2	8.0	39.5	4.2	3.3	7.9	1.6	-	19.8
FB 3	3.7	1.6	0.0	0.4	16.9	40.3	1.4	16.6	8.3	1.7	-	1.5
LC 1	6.7	0.5	0.8	0.0	1.4	52.9	5.4	5.2	12.9	24.1	-	4.0
LC 2	4.6	0.5	1.2	0.0	2.3	80.7	7.5	3.5	12.0	14.9	-	24.0
LC 3	0.0	2.0	0.7	0.2	4.9	31.1	4.9	15.3	17.4	16.6	-	13.0

NB = Nuevo Berlin, FB = Fray Bentos, LC = Las Cañas