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Washington, DC
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Ms. Rachel Kyte, Director
Environment and Social Development Dept.
IFC, 2121 K Street, NW
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Re: Cumulative Impact Study – Uruguay Pulp Mills

Dear Mr. Tsitsiragos/Ms. Kyte:

Based on a review of the Cumulative Impact Study (CIS) for the Uruguay pulp mills and a consideration of comments on the study that have been submitted to date, certain issues are highlighted herein as requiring additional consideration by proponents of these mills. A panel of two experts, Mr. Neil McCubbin and myself, prepared the comments/concerns submitted in accordance with the Terms of Reference provided to us by the International Finance Corporation (IFC).

The documents reviewed to date that relate to these developments include: the IFC CIS; the Botnia EIA; the CMB EIA; the Argentina Analysis and Observations on the Draft CIS of the IFC; comments on the CIS by the Center for Human Rights and Environment; and all other stakeholder comments provided by the IFC (Annex 1). The issues of concern presented herein relate primarily to the CIS, with additional reference to the Orion (Botnia) and CMB (ENCE) Environmental Impact Assessments (EIAs).

The issues are categorized, and points of clarification are provided for each, with recommendations. The issues raised will be presented in three major categories, "CIS/Mills Pre-operational", "CIS/Mills Operational", and "Orion/CMB EIAs". Some issues form the focus for a number of topical comments presented with reference to the highlighted issue, followed by recommendations for each respective comment.

In advance of the detailed presentation of our issues, a "Preamble" introduces some general comments on findings related to the two pulp mill developments.

PREAMBLE

Technical approach to mill design and operation

Proponents of Botnia and CMB mills based the environmental protection aspects of their mill designs generally on "Best Available Techniques" (BAT; Annex 2)[1] as defined by IPPC (2001). This is reasonable, since it is widely recognized as the best current definition of appropriate environmental protection measures for the pulp industry. However, there is a lack of supporting information in their documents to show that the mills would actually use BAT in all aspects of their design and operations.

Further, there have been some improvements in environmental protection techniques since the IPPC document was published in 2001, which the draft CIS and the mill EIAs have not considered.

Technical validity of comments received on the draft CIS

Most of the comments receive on the draft CIS were negative, which is normal in this type of controversy, since opponents are usually the most vocal stakeholders. Assertions that the CIS, Botnia and CMB have not provided sufficient information on the proposed design, operating procedures and environmental monitoring for the mills are generally valid.

Comments expressing concern that the mills will cause catastrophic environmental damage are unsupported, unreasonable and ignore the experience in many other modern bleached kraft pulp mills. However, some comments suggesting improvements to certain aspects of the mill design, definitions of operating procedures and environmental discharge monitoring are valid, and merit implementation.

Comments asserting that only a totally chlorine free (TCF) bleaching process is acceptable are unsupported, either by their authors, or by current scientific knowledge. There are some environmental advantages in the TCF process, some of which can be attained if the mill design is modified to an "ECF-light" version where the quantity of chlorine dioxide used is relatively low, or the alkaline bleach plant effluent is recycled to the mill's chemical recovery system.

Major weaknesses in draft CIS

Many of the faults in the draft CIS represent a lack of information, rather than environmentally deficient factors in the proposed mill designs and operations. In some respects, the design of the mills and proposed operating and monitoring procedures can be improved. These issues can probably be resolved to the satisfaction of most stakeholders who approach the issue logically.

The panel did not find any reason to support the predictions of catastrophic environmental damage in the receiving environment that have been presented by several stakeholders.

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[1] *In the USA, "BAT" refers to "Best Available Technology" . While similar in its purpose as a tool to control environmental impact of pulp and paper mills, its legal concept and technical level is quite different from BAT as discussed by IPPC. Unless otherwise stated explicitly, "BAT" in this document refers to the European definition.*

The following weaknesses in the CIS and underlying EIA reports exist:

1. Recovery and incineration of approximately half of the bleach plant effluent is considered part of BAT by the IPPC; this process is not implemented in either the Orion or CMB mills. It is a proven technology that would reduce the discharged effluent to the Rio Uruguay. The reduction achieved in individual waterborne pollutants would vary, primarily in the range of 25% to 50%.

2. The CIS and the proponents' EIA documents do not define the mill designs in sufficient detail to determine that the mills will indeed use BAT. Qualitatively, the companies appear to 'plan' to use BAT (except as mentioned in the preceding paragraph); however, a number of design parameters require specification before IFC or other stakeholders can make a final assessment. The companies should be able to provide sufficient information on mill design features that are currently vague in the EIA documents. It is clear that many of the concerns expressed by third parties regarding the mills are based on assumptions that the proposed mills will operate in a similar manner to many older, obsolete mills. This is quite understandable, given the lack of definitive information in the EIAs and CIS.

3. As stated by IPPC (Integrated Pollution Prevention and Control), Best Available Techniques change with time. The current BREF (BAT Reference Document) was published in 2001, and is actually a reflection of technical work undertaken in 1999/2000. Some techniques for further reducing effluent discharges have come into common use since then, and should therefore be considered for the Uruguayan mills. These techniques include the partial replacement of chlorine dioxide by ozone, and reduction of effluent flows. Effective use of ozone or pressurized hydrogen peroxide in the bleaching process would reduce BOD, COD, AOX and dioxins/furans. Reducing the effluent flow reduces BOD and suspended solids discharges, since there is a practical minimum concentration of these pollutants in biologically treated effluent. The final CIS should analyze these techniques in depth.

4. There is no complete listing of discharges to the natural environment in the vicinity of the mills. The final CIS, or associated documents such as updated EIAs, should include a complete list of atmospheric emissions and effluent discharges of all substances mentioned in connection with Kraft mills in the IPPC BREF. Estimates should be based on the process design proposed, and not simply generic references to the BREF or other documents.

5. There does not appear to have been any independent review of the estimates of pollutant discharges presented by the companies. A brief review of the EIAs presented by Orion and CMB suggests that the data presented overestimates the quantities of many pollutants that will actually be discharged. Excessively conservative estimates distort the evaluation process, and lead to unnecessary concerns on the part of the public. Estimates that are below the actual discharges similarly distort the analysis.

6. The reference to dioxins/furans in mill discharges appears to be handled in a rather cavalier manner. These compounds are of significant concern to the general public,

and should be discussed fully. Setting the issue aside by concluding that dioxins/furans will be at "undetectable levels" is unacceptable.

7. There is a scarcity of data in the CIS regarding Uruguay River water quality and biological resources, particularly related to the bay area downstream of the proposed Botnia effluent discharge. This region remains a concern due to the possible accumulation of effluent constituents.

8. Issues related to the Fray Bentos water intake, endocrine disrupting compounds, effluent plume delineation, and the detailed monitoring strategies for wastewaters and air emissions require additional discussion. In order to render a thorough understanding of these issues, and for the general public to arrive at an acceptable level of comfort that concerns will be addressed in a satisfactory manner, proceeding to achieve this objective is strongly recommended.

9. Predictions of the concentrations of atmospheric pollutants in the area within approximately 40 km of the mill neglect to consider existing concentrations of the same pollutants. These should be added to the concentrations that would be caused by the mills (i.e., cumulative assessment) before drawing conclusions regarding health and other impacts. In addition, the predictions omit a discussion on the reductions in atmospheric pollutants that will probably result from the pulp mills selling electric power to the Uruguayan system, thus replacing fossil fuel combustion with more environmentally desirable biomass.

10. The well known capability of traditional Kraft mills to emit malodorous gases that inconvenience people many kilometers away is the basis for many negative comments on the mills. These gases are generally known as "Total Reduced Sulfur" (TRS). The draft CIS employed one of the best and most widely accepted tools for prediction (or modeling) of the concentrations of TRS gases that will occur at ground level, and then, unfortunately, went on to predict perception of odor by referring to odor thresholds. This approach is approximate at best, and should be supplemented by reference to practical cases. The final CIS should discuss the practical limitations of dispersion modeling for prediction of odor from Kraft mills. The final CIS should include discussion and data on the history of odor nuisances in actual mills using comparable technology. If possible, this approach should included mills owned by Botnia and ENCE. Measures should be described that would ensure vents from **all** tanks, and other equipment in the mills emitting TRS gases, are collected and burned. (The comment does not refer to the lime kiln, recovery boiler or effluent treatment system, which are addressed separately)

A. CIS/MILLS PRE-OPERATIONAL

A1. Issue: General lack of information

Comments: It is apparent from many comments by third parties opposing the mills that at least some of the concerns they express are based on a lack of information, which in turn leads to distrust. By referring to the good environmental track record of Botnia and ENCE, and current pulp industry design practices, it is possible, if not probable, that

many of the issues of concern to third parties will be adequately addressed in the normal course of mill design and construction. However, the documents in the public domain do not provide sufficient information for stakeholders outside Botnia and ENCE to form reasoned opinions on many issues.

Recommendations: The final CIS should provide more information to stakeholders, to improve their understanding of the data presented and allow them to reach reasoned conclusions on the proposed mills. In some cases, it may be appropriate for the companies to undertake specific commitments on mill design and operation to allay unnecessary concerns on the part of the public and the Government of Argentina.

A2. Issue: Verification of discharge estimates

Comments: There is no apparent verification of the discharge estimates presented by the mill developers.

Recommendations: The final CIS should include an audit of the discharge estimates. This need not require major resources, given that experts in the field can review the mill design and compare the estimated discharges with their own experience. Alternatively, the companies can confirm their predictions by undertaking a legal commitment to operate below the estimated levels.

A3. Issue: Comparison of mills with Best Available Techniques (BAT)

Comments: The draft CIS compares the proposed mill designs with BAT. Table A-2 in the draft CIS lists design features of the mills, and indicates that each mill has virtually all the features indicated. Several comments by third parties assert that the mills will not comply with BAT standards. The above mentioned comparison of the proposed mills with BAT in the draft CIS is deficient in that it omits bleach filtrate recycle measures to minimize chlorine dioxide use, and measures to minimize effluent flow. Most importantly, the BAT features are treated qualitatively, whereas many require quantitative assessment. Table 1 lists the key features of BAT, and indicates whether they are to be implemented in each mill. In many cases, there is no evidence in the documents provided by the companies or the IFC consultants that the features will exist in the mill as designed and installed, or will exist with adequate specifications. It seems probable that, in at least some aspects, the mill designs are compatible with BAT, although the information has not been presented to the public and IFC. Both EIAs are replete with generic descriptions of modern mill features (much of Orion EIA text is copied from IPPC 2001), with little information on what the company is actually intending to install. Since a significant time has passed since the EIAs were written, the companies are probably in a much better position today to provide information on mill design features that are rather vague in the existing EIA documents.

Recommendations: The final CIS, or any supporting EIAs, should define the design features of the mills sufficiently for a final assessment of the extent of compliance with BAT by IFC, and by all stakeholders.

Table 1 BAT *vs*. available mill design data. (Two pages)

BAT feature	Orion mill	CMB mill	Comments
Dry debarking of wood	Yes	Yes	Both mills comply with BAT
Extended cooking	Yes. To kappa 15	Yes. To unspec. kappa	CMB should specify design kappa number of pulp leaving digester.
Highly efficient brown stock washing	Yes. EIA quotes E value 10-12	Probably, but not specified	Companies should specify fraction of black liquor generated in digestion process that will be recovered by washers. Should be over 99%. Also specify Norden's E factor for the brown stock washing systems.
Closed cycle brown stock screening	Yes	Unknown	CMB EIA does not specify that brown stock screening is closed.
Oxygen delignification, (with additional stages)	1 or 2 stages, not clear. To Kappa 10	Yes, but not defined	CMB should specify number of stages of oxygen delignification and kappa number of pulp before bleaching. Kappa should be 11 or less.
ECF bleaching with low AOX (or TCF)	ECF, but not the lowest AOX attainable	ECF, but not the lowest AOX attainable	Consumption of chlorine dioxide should be stated explicitly, along with expected AOX discharges before and after biological treatment. Values implied in EIA are rather high.
Recycling alkaline effluent from the bleach plant	Absent	Absent	Final CIS should analyze, and if this BAT feature is to be omitted, it should be justified.
Effective spill monitoring, containment and recovery system	Perhaps	Perhaps	Both state that they are installing systems, but more detailed description is required to assess their probable effectiveness.
Stripping of the condensates from the evaporation plant	Yes	Yes	Quantities and efficiencies should be defined in final EIAs and CIS.
Reuse of the stripped condensates from the evaporation plant	Partial	Partial	Companies should analyze, and justify all discharge of condensates.
Sufficient capacity of the black liquor evaporation plant to concentrate recovered spills for burning	Unclear	Unclear	Capacity (m^3/hour or equivalent) and expected normal hydraulic load on the evaporators should be specified, as well as the margin for upsets. Also provisions for boilout, maintenance etc without major black liquor discharge.
Sufficient capacity of the black liquor recovery boiler to cope with the additional liquor and dry solids load	Unclear	Unclear	Capacity of boiler (total BL solids per day) and expected load should be specified, along with margin for upsets.
"Low odor" design recovery boiler	Yes	Yes	Both mills comply with BAT. (Low odor is an American term referring to the absence of a direct contact evaporator evaporator.)
Collection and reuse of clean cooling waters	Yes	Yes	Both mills comply with BAT.
Adequate tanks for storage of spilled cooking and recovery liquors and dirty condensates to prevent peaks of loading in the effluent treatment plant	Unclear	Unclear	This is difficult to specify and assess before mill detail design is complete.

BAT feature	Orion mill	CMB mill	Comments
Primary effluent treatment	Yes	Yes	Both mills comply with BAT.
Biological (secondary) effluent treatment	Yes, but not well defined	Yes, but not well defined	Both mills appear to comply with BAT, but key design criteria should be specified.
Common chimney for boilers, lime kiln and smelt tank vent.	Yes	Yes	Both mills comply with BAT (may incinerate smelt tank vent in boiler instead).
Incineration of Low-volume High Concentration non-condensable gases (LVHC)	Yes	Yes	Both mills appear to comply with BAT, but key design criteria should be specified, particularly the process streams involved.
Incineration of High-volume Low-concentration non-condensable gases (HVLC)	Yes, but inadequately defined	Yes, but inadequately defined	Both mills appear to comply with BAT, but key design criteria should be specified, particularly a list of the process streams involved. Several mills have caused odor problems because some process streams were omitted.
Back up incineration for non condensable (odorous) gases	Yes	Yes	Instantaneous transfer from main source to standby is best. Final EIAs and CIS should discuss this and companies specify changeover time required.
Continuous monitoring of SO2, TRS and particulate from kiln and boilers	Some	Some	More comprehensive system necessary for BAT.
Pulp sheet formation with closed water loop	NO	Unknown	Orion water balance shows effluent from pulp dryer. This can be avoided.
Storage for entire mill effluent in event of excess discharge	Inadequate description	Inadequate description	Companies should describe facilities for temporary storage of unusually high effluent discharged, how the material will eventually be recovered or treated before discharge, including the total volumes of each retention vessel and the normal flow of the stream to be stored. (This does NOT refer to the sumps in each department for recovery of local spills, but to one or more large basins to store all, or a large proportion of the mill effluent to prevent overloading the effluent treatment plant.)

A4. Issue: Effluent treatment

Comments: A number of comments by the public assert that details of the treatment system for Botnia are lacking, and absent for CMB, in the information available. They desire flowsheets, balances and pollutant removal calculations.

Recommendations: The final CIS, or any updated EIAs or associated documents, should include the process flowsheets, major equipment design criteria, and pollutant removal estimates, for the effluent treatment systems and major air pollution control devices, with technical support**.**

A5. Issue: Effluent Dioxin/Furans

Comments: On page 14 of the CIS, it is stated "…full replacement of elemental chlorine by chlorine dioxide results in the decrease of dioxins and furans in the effluent to undetectable levels". This statement may be true depending on the level of detection being used. There is no indication in the document as to what the level of detection is in relation to this statement – is it parts per million (ppm), parts per trillion (ppt), or parts per quadrillion (ppq). In Canada, the compliance level for dioxins (2,3,7,8-TCDD) in pulp and paper mill effluent is less than 15 ppq, and for furans (2,3,7,8-TCDF), less than 50 ppq. Some pulp mills in Canada, using 100% chlorine dioxide, do generate very low levels (near detection at the ppq level) of higher chlorinated (lower toxicity) dioxins (e.g., octa dioxins) and furans (2,3,7,8-TCDF). In the US, the compliance limit for 2,3,7,8-TCDD is 10 ppq, and 31 ppq for 2,3,7,8-TCDF. Since these are measured at the bleach plant, they are effectively more stringent by a factor of at least three when related to the final effluent discharge. In practice, current laboratory techniques employed in labs experienced in dioxin/furan analyses can measure 2,3,7,8-TCDD/TCDF to the level of 1 ppq.

Recommendations: Clarify what units are being referred to in the above statement of "undetectable levels". Clarify the congener profile of the dioxins/furans that may be discharged. If the CIS continues to maintain that dioxins/furans will not be detected in the final effluent, this statement would only hold if the ppq units are considered, given that laboratories do exist that employ that level of detectability. The CIS must provide proof that "undetectable levels" will be the case for dioxins/furans if that statement is carried through into the final CIS.

A6. Issue: Minor factual inaccuracies

1. **Comments:** CMB will use ozone (presumably to replace some chlorine dioxide), but there is no mention of ozone in CMB EIA.

   Recommendations: This should be clarified in the final CIS.

2. **Comments:** Orion will discharge metals and salts, but CMB will not. This is inaccurate, since both mills have to discharge metals and salts.

   Recommendations: This should be corrected in the final CIS.

3. **Comments:** CMB will discharge resin acids but not Orion. This is inaccurate, since both mills are bound to discharge resin acids.

Recommendations: This should be corrected in the final CIS.

4. Page (vii) of the draft CIS states that the additional 65,000 hectares of plantation is only 1% of current plantations in the region. This is inconsistent with other data.

   Recommendations: The final CIS should correct this and all factual inaccuracies.

A7. Issue: Reference to European standards

1. **Comments:** The CIS states (page 14) "Both plans will meet the high standards required in Europe for new operations". This is a sweeping statement, and while not necessarily wrong, is somewhat speculative.

   Recommendations: The final CIS should provide supporting evidence by reference to new European bleached Kraft mills, particularly those in Germany and Austria, or delete such speculative statements.

2. **Comments:** The draft CIS (page 41) states that increased forestry operations have and will provide more jobs than previous farming activities. Many dispute this.

   Recommendations: This statement should be supported in the final CIS, or deleted.

3. **Comments:** Under the "air-quality" sub-heading, page (vii) the draft CIS states that emissions of air pollutants will be well within European Union accepted standards. This is unreasonable, since there is insufficient information in the mill EIAs to determine values for all the emissions, and the "accepted standards" in the EU are a very complex mixture of regulations and individual mill permits. Any such sweeping statement should be substantiated. Unless supported, such statements are liable to infuriate some members of the public.

   Recommendations: The final CIS should either remove comparison with EU air emissions as a broad subject, or treat it in full detail.

A8. Issue: Public criticism of air modeling

1. **Comments:** Critics have asserted that the modeling software used by the CIS authors to predict ground level concentrations of atmospheric pollutants is not suitable over coastal areas, like Fray Bentos. The modeling software used, ISC3, is widely accepted and is routinely used successfully in North America. There have been many successful applications over the past 20 years (including earlier versions of the ISC software). The ISC3 modeling software is well described in Appendix C of the CIS. It would be helpful to readers of the CIS if its authors included references to successful applications in situations comparable to the Orion/CMB projects. (The USEPA introduced new software in late 2005, known as AERMOD. It could perhaps have been used, but given the lack of experience with it in pulp mills, it is at least as valid to use the well proven ISC3 for the Uruguayan mills.)

   Recommendations: Consider ISC3 as acceptable, and add supporting information to the CIS.

2. **Comments:** Critics have asserted that prediction of ground level concentrations of atmospheric pollutants was based on weather data from a very short timeframe (at least one commenter asserted one year). The predictions were based on weather data from a 5-year period. This is somewhat shorter than normal practice, but is quite satisfactory. There is very unlikely to be any practical difference if a longer time frame were used.

   Recommendations: Accept CIS on this point.

3. **Comments:** Critics have asserted that prediction of ground level concentrations of atmospheric pollutants was based on estimations of atmospheric stability instead of locally collected data on the mixing heights in the atmosphere. The approach used is quite common, and widely accepted, particularly when the model is used outside the US, or far from major weather monitoring stations. Five years or more would be required to perform atmospheric stability testing to establish mixing heights on the mill sites, so that no modeling could be undertaken if one insisted on local meteorological data.

   Recommendations: Accept CIS on this point.

4. **Comments:** Critics have asserted that prediction of ground level concentrations of atmospheric pollutants failed to consider variations in elevation of terrain. The modelers chose to ignore the variations in terrain elevation. This may well be reasonable, given the relatively flat terrain in the area. It is expected that including terrain will have only a very minor effect on the calculated concentrations of pollutants, however the credibility of the CIS will be enhanced if this is undertaken. Given the ease with which ISC3 models non-flat terrain, it may be best to simply model the terrain as it is, using the best local maps available.

   Recommendations:

   1. The decision by the authors of the Pirnie report (CIS annex C, page 4) to consider a 3 km radius circle for analysis of the significance of terrain should be supported or modified. Good modeling practice considers terrain elevations for the full area modeled, which extends at least to Gualeguaychu.

   2. When updating the atmospheric emission modeling for the final report, include terrain effects, or substantiate neglecting them.

A9. Issue: Expert's criticism of the atmospheric emission modeling

1. **Comments:** The atmospheric emission dispersion modeling procedures used to predict ground level concentrations of atmospheric pollutants has been criticized by various third parties. Overall, the quality of the atmospheric emission dispersion modeling appears to be good, and generally adequate for the purpose, however some of the information that the model calculated is omitted. The report fails to explain some key points, which detracts from its credibility. Also, the report is needlessly repetitive, detracting from credibility, and perhaps leading to criticisms from third parties who do not read the full report.

Recommendations: The final CIS should include predictions of the ground level concentrations of SO_2, NO_2, Particulate Matter (PM) and Total Reduced Sulphur (TRS), which reflect the various recommendations herein on modeling techniques and emission data from the mills. Pollutants emitted at low elevations (such as from the effluent treatment plant and leaks from the mills) and the existing ambient concentrations of pollutants from non-mill sources should be included

2. **Comments:** The CIS calculates the concentrations of SO_2, NO_2, Particulate Matter (PM) and (as a tool to predict odor detection) Total Reduced Sulphur (TRS) that will be caused by the mill. It ignores the 'existing' ambient concentrations of these pollutants. The Botnia EIA for the Orion mill has some information on this issue.

   Recommendations: The model results should incorporate current local ambient concentrations, at least by simply adding the annual averages to the contribution from Orion and CMB mills.

3. **Comments:** The model is based only on the emissions from the main mill stacks. It ignores the fact that some, and possibly most, of the TRS emitted will be from the effluent treatment plant, and will thus disperse very poorly. This is liable to cause high local odors, but have little impact at greater distances.

   Recommendations: TRS emissions from the effluent treatment plant, and from open effluent channels in the mill should be estimated and included in the air modeling for the final CIS. If the authors consider these emissions to be negligible, this assumption should be supported by references to comparable mill experience.

4. **Comments:** The atmospheric emission modeling ignores VOC emissions, which are known to exist in pulp mills.

   Recommendations: VOC emissions, including methanol from the effluents and open tanks, should be discussed, and either shown to be trivial by reference to data from mills with similar control technology, or be modeled and assessed.

5. **Comments:** The draft CIS omits discussion of the visibility of atmospheric emissions from the mills. All pulp mills emit plumes of water vapor, which are visible under some weather conditions. However, they dissipate rapidly, and are universally considered as harmless. There is some emission of substances that impair the clarity of the atmosphere at distances over 1 km from the mill. This may or may not be significant, depending on the design of atmospheric emission controls.

   Recommendations: Visibility of emissions should be discussed in the final CIS, and perhaps modeled and assessed.

6. **Comments:** The CIS refers to "Health standards" for ambient SO_2, NO_2 and PM, and indicates sources in Table 4. There is no discussion of Argentinean or Uruguayan standards.

   Recommendations: Existing Uruguayan and Argentinean standards should be stated, or if non-existent, this should be stated. Where the most stringent

international standards are more stringent than the local ones, they should be shown along with the local ones.

7. **Comments:** The model assumes a relatively high emission rate when the mills burn No. 6 oil on startup. This is a realistic worst-case for a pulp mill. However, there is no discussion of the number of hours per year that this condition will occur. Further, the Orion mill has no way of raising steam without running the recovery boiler, however there is no analysis of the extent (if any) to which the Orion mill will burn No. 6 fuel oil to supplement black liquor.

   Recommendations: Include the above-mentioned analysis, and the associated emission modeling in the final CIS.

8. **Comments:** Location of peak concentrations of atmospheric pollutants is within a kilometer of one of the two mills in all cases (Figures 7, 8 and 9 of Annex C). In modeling mills where most emissions are from high stacks, the point of maximum pollutant concentration is normally much further away. Tables 5, 6 and 7 of Annex C indicate peak concentrations at 6 to 7 km.

   Recommendations: The modelers should review their calculations, and if the calculated values, or maps in Figures 7, 8, and 9 are indeed accurate, discuss this unusually close location in the final CIS. If the Expert Panel's interpretation of Annex C is wrong, perhaps some further explanation is necessary for readers.

9. **Comments:** The objective of the atmospheric emission modeling was stated to demonstrate that the operation of the two mills would not cause an adverse impact on health in the surrounding areas (page 11). This suggests that the modelers prejudged the issue (although there is no indication of such prejudice in the technical work). Page 12 states that modeling was conducted out to 20 km from the mills, whereas the text of the report shows that it extended much further.

   Recommendations: Improve wording of the final CIS.

10. **Comments:** Modelers appear to have considered worst-case meteorological conditions along with worst-case emissions for predicting incidence of odor. It is normal to perceive disagreeable odors in day-to-day life, due to, for example, bad meat, garbage, or diesel fumes, etc. It would be appropriate to discuss the realistic extent of odor perception.

    Recommendations: In the final CIS, the probable frequency and locations of odor perception should be discussed more intensively, and compared with the current situation.

11. **Comments:** Modelers do not discuss odor perception at the key locations where people congregate (Guyelaguaychu, Nandubaysal, etc.).

    Recommendations: Add data on predicted concentrations of TRS gases at the locations of particular interest in the CIS.

A10. Issue: Air quality – Argentina

Comments: The CIS suggests that the impact on air quality of Argentina, and in general, will be minimal. These projections are based on air modeling presented in Annex C of the CIS, and through the selection of certain wind flow patterns. Comments by stakeholders have suggested that wind direction onto Argentina's territory, for example, is of a greater frequency than that stated in the CIS, and that odours, in particular, could be more prevalent in the region than that described in the CIS. Some stakeholders have indicated that the lack of accurate meteorological data and the lack of consideration regarding fugitive emissions, including ground level TRS from the wastewater treatment facility, renders an incomplete 'picture' of air quality/modeling for the development region. Given the sensitive issue of local tourism, reliable and complete input parameters to the models are required for impact prediction.

Recommendations: The data for the air model should be confirmed as consisting of the most up-to-date on wind flow patterns and other meteorological information for both the Orion and CMB sites. If these data do indicate a greater prevalence of directional winds towards Argentina, a more comprehensive treatment of this phenomenon must be included in the final CIS. Fugitive emissions should also be considered in the overall analysis; these being, as listed by one critic: marine loading/unloading; wastewater treatment; landfill operations; truck traffic; and pulp dryers. Where the modeler considers any source as trivial, his/her assumption(s) should be justified.

A11. Issue: Overview of Uruguay River water quality and aquatic resources

Comments: The CIS contains very little baseline water quality and aquatic resource data pertinent to the Uruguay River. In order for the reader to gain a rudimentary understanding of the physical, chemical, and biological environments of the river, summary tables for these variables should be included in the CIS final document. An example is Table 3-1 in the EIA summary for the Botnia mill (dated December 2004). This table presents mean, maximum, and minimum values for specific water quality parameters. Other physical/chemical parameters, where data exist, should be included in this table format. On page 24 (CIS) the statement is made "… the river … shows clear signs of pollution by human waste and industry, and gradual deterioration in water quality over time". Given that there exists significant concern regarding the quality of the Uruguay River, the final CIS document should provide direct reference data on existing characteristics (e.g., dissolved oxygen, nitrogen, phosphorus, sediment loads). Similarly, the aquatic resources (e.g., fish species) of the Uruguay River are not presented in the CIS in a manner that provides a reasonable understanding of the species and numbers that reside in various sectors of the river system. Specific spawning, feeding, and rearing areas for fish should be included in the CIS as these data may affect construction windows involving instream work. The locations and value of the commercial fishery, and that of the small-scale fishery, should be clarified.

Recommendations: The final CIS should include overview tables and discussions of the physical, chemical, and biological environments of the Uruguay River to provide the reader with site-specific information on those variables in the system that have the potential to be impacted by pulp mill effluents.

A12. Issue: The bay downstream of the Orion mill

Comments: Numerous comments/concerns have been made by stakeholders regarding the bay situated immediately downstream of the Orion mill site, and its sensitivity to potential habitat alterations. Comments regarding this bay and its positioning also appear in the CIS, wherein it is stated that "… this area is still of potential concern, particularly in view of elevated background nutrient levels in the river" (page 49). Given that the hydrological model suggests that mill effluent components could, at times, accumulate in this bay due to "… a potential slow-flowing circulation pattern in the bay …", this area remains a concern for potential impacts. The CIS and Botnia EIA do not describe in any detailed manner the water quality of this bay, or the aquatic resources (flora and fauna) that inhabit this area on a temporary and/or permanent basis. Given the location of this bay, relative to the potential effluent diffuser (Orion), and the suggestion that the CMB effluent plume may merge with Orion's plume during low flows, it is important to understand the resources and habitats that may be impacted in this sector of the Uruguay River.

Recommendations: More definitive physical, chemical and biological field investigations should be directed at the bay area downstream of the Orion site extending upstream to the CMB mill site. Seasonality, and resulting usage of this region by some river resources during specific times of the year, should be a consideration in the planning of any investigation. Environmental investigations undertaken prior to the discharge of effluents from both pulp facilities would provide valuable pre-operational data on 'existing' conditions that would enhance the scientific credibility of future environmental monitoring programs executed during the operational phase of the mills.

A13. Issue: Fray Bentos water intake

Comments: Presently, the water intake for Fray Bentos, a city of over 20,000 inhabitants, is situated 3 km downstream of the Orion site. Options for relocation of the water intake have been advanced, one of which involves locating the intake upstream of the Orion effluent discharge. However, this location would be approximately 6 km downstream of the CMB discharge. The CIS does not address the issue of drinking water quality as related to discharged effluent, assuming that the final configuration of the Fray Bentos water intake will remain downstream of one or both pulp mill effluent diffusers.

Recommendations: The CIS in its discussion on river water quality should address potable water concerns related to the positioning of a water intake for the City of Fray Bentos downstream of an effluent discharge. It may be necessary to consider the various configurations of intake position during these discussions (e.g., Fray Bentos intake downstream of both mill discharges; and Fray Bentos intake upstream of Orion, but downstream of the CMB effluent discharge). The experience of other international pulp mills on river systems may have to be reviewed to provide insights into this potential water quality issue as it relates to potable water for the citizens of Fray Bentos.

A14. Issue: Effluents and Endocrine Disrupting Compounds (EDCs)

Comments: In Canada and other countries, it has been shown that in some instances fish inhabiting regions downstream of pulp mills may experience gonadal changes, relative to fish not exposed to discharged effluent. It is suspected that EDCs may be a component of

pulp mill effluent, and may result in alterations to the hormonal balance of exposed fish. This phenomenon is not characteristic of all pulp mills, and the basic fundamentals of the process are not fully understood. A rather large knowledge gap exists in the science of EDCs as they may relate to pulp mill effluent and its impact/relevance to individual fish, and in a more ecological sense, the population level of fish communities. Inherent in Canada's Environmental Effects Monitoring program is the determination of effluent dilution and the characteristics of its dispersion following discharge into the receiving environment. If, for example, discharged effluent from a pulp mill achieves a 100:1, or 1%, dilution within 250 metres of the effluent diffuser, a fish monitoring program is not required. It is believed that with this level of initial dilution, no measurable effects on the fish parameters considered would be detected. It is anticipated that over the next 5-10 years more information on this phenomenon, and its relevance to aquatic ecosystems, will become available through directed research.

Recommendations: The CIS should summarize the EDC issue as it may relate to the two pulp mills on the Uruguay River.

A15. Issue: Effluent dioxins/furans and fish tissues

Comments: Throughout the comments from stakeholders, there is reference to the potential bioaccumulation of dioxins/furans in local fish. The CIS states that dioxin/furan concentrations in mill effluent will be "undetectable". As noted elsewhere in this document, this statement is unacceptable without scientific support. It is true that the conversion from elemental chlorine to chlorine dioxide results in the decreased production of these specific organochlorines, with the load to the receiving environment also being significantly reduced. At this time, there appears to be no information regarding dioxin/furan loads in Uruguay River fish populations that would provide a reading on the present 'background' levels.

Recommendations: In order that all stakeholders have reliable data on the 'existing' condition of fish populations (mills pre-operational), with respect to dioxin/furan concentrations, it is recommended that a fish collection program be implemented on the river addressing background levels of these organochlorines. Specific quality assurance/quality control protocols must be applied to prevent cross-contamination, thus enabling generation of reliable data. An internationally accredited laboratory proficient in dioxin/furan testing should perform laboratory analyses on tissues. These data would provide all stakeholders with pre-operational data, which would be highly beneficial in any future comparative investigations performed during the operational phase of the mills.

A16. Issue: Effluent plume dispersion

Comments: The objective of an efficient/effective effluent diffuser is to disperse discharged effluent into the receiving environment to maximum dilution as quickly as possible. Given the small bay downstream of the Orion mill, and its sensitivity to issues of water quality, fish usage, and overall potential habitat alteration, a comprehensive plume dispersion model for both Orion and CMB should be considered <u>mandatory</u>. Use of a dispersion model such as USEPA Plumes, with follow up three-dimensional modeling, would enable determination of diffuser length, the number of ports, their diameter, and spacing in order to achieve maximum dilution in as short a distance as possible. This

approach would maximize dilution potential of the river system in the vicinity and downstream of each pulp mill operation.

Recommendations: To proceed with effluent dispersion modeling as soon as possible taking into account effluent temperature and various river flow patterns (e.g., maximum, minimum, average, reverse, and zero flow [if present]). This approach would define more precisely the effluent mixing zone, and the regions of highest dilution potential.

A17. Issue: Tourism

Comments: It is stated in Annex F, page 35, that "The Municipality of Gualeguaychu is very active with tourist activity". On page 46 it is also stated that "The possibility of offensive smells… changes in the pristine nature of the countryside… and the increase in heavy goods traffic could deter tourism in the area of influence". It would appear that tourism is a major economic engine in this region. However, the CIS does not review the tourism industry in economic terms.

Recommendations: Given the importance of tourism, the CIS is obliged to clarify, in financial terms, the tourism sector in this region. This would promote an understanding of annual returns and enable the development of mitigative economic strategies if tourism losses do, in fact, come to fruition, as per the stated possible negative impacts of odour, perceptional changes in the natural environment, and traffic.

A18. Issue: Plantations – Biodiversity

Comments: The CIS states (page 42) that "…plantations provide an improved habitat structure with more niches for a greater variety of flora and fauna, thus increasing biodiversity…". If this statement is to be accepted, the CIS must outline field investigations on biodiversity structure in Eucalyptus plantations versus grasslands; before and after studies would provide the best data. Historically, what studies on this topic, involving Eucalyptus plantations, have been undertaken that would lead to the above conclusion regarding an increase in ecological niches?

Recommendations: The CIS should provide/describe quantitative field investigations in the literature that substantiate the statement made on page 42.

A19. Issue: Plantations – Water Management

1. **Comments:** It is stated in the CIS, Annex B (report by SGS to the Forest Stewardship Council), that "…the main environmental effect of Eucalyptus is known to be its heavy use of groundwater. Since water is not currently a limiting factor in Uruguay, this is apparently not of immediate concern." However, there is indication that more research is necessary. Apparently, there are two long-term watershed studies underway in Uruguay; conclusions are yet to be reached. Weyerhaeuser is also undertaking a study in Uruguay on the impact of plantations on the water table. Others have also suggested investigations be directed at plantations and water management. More specifically, the CIS suggests that Orion and CMB cooperate to support an independent long-term study on this topic. It would appear that the issue of Eucalyptus plantations and water management continues to spawn ongoing research and recommendations of additional research on the subject. However,

regarding the Orion/CMB projects, the conclusions expressed in the CIS that soil type restricts root penetration by Eucalyptus in Uruguay, and "Most forests in Uruguay are planted in relatively small patches…", tends to suggest that a moratorium on Eucalyptus plantations in Uruguay is not required.

Recommendations: The CIS concludes that plantation developments could proceed; however, there is also a suggestion that the two companies cooperate on longer-term research regarding the water table and plantations in order to provide monitoring data from their respective lands. These recommendations are echoed herein.

2. **Comments:** A few comments by the public complain that there is no mention whatsoever regarding the interaction with the Guaraní Aquifer.

   Recommendations: The final CIS should discuss interaction with the Guaraní Aquifer, or justify its omission.

A20. Issue: Elemental Chlorine Free (ECF) versus Totally Chlorine Free (TCF)

Comments: Throughout the review of many stakeholder comments, the topic of ECF and TCF is raised repeatedly. The CIS document indicates that for the two pulp mills, the ECF option will be implemented. The document fails to provide a solid justification for the ECF approach versus the TCF option. Botnia has extensive experience with TCF, having built (in 1995) and operated the only mill in the world designed to produce only TCF pulp. There is other experience with TCF production available.

Recommendations: Given stakeholder concerns and their clear perception that a truly viable bleaching option is being negated for no good reason, the CIS must provide a complete, logical, and rational argument for selection of ECF over the TCF process.

A21. Issue: Fish tainting

Comments: The unacceptability of fish flesh for human consumption, due to offensive taste and odor, has been an issue related to wastewater discharges from some pulp and paper mills. In Canada, if complaints are received from the general public, programs must be implemented by the mill to investigate and assess the impact of pulp mill effluents on fish usability. Ultimately, if an industry is shown to directly impact the taste and odor of fish flesh, remedial measures are required to eliminate these occurrences. The CIS, in its coverage of wastewater effluents from both Orion and CMB mills, makes no mention of the potential for tainting of fish flesh, other than in concerns expressed by stakeholders summarized in Table 4.2, page 36 (of the CIS), wherein it states "…making them inedible." Given the relatively high level of dilution of mill effluent in the Uruguay River, this is not expected to be a serious environmental issue. However, its omission from the CIS as a 'potential' concern needs to be addressed.

Recommendations: The issue of pulp mill effluents and their potential for creating unacceptable taste and odor in local fish species should be thoroughly addressed in the CIS document. It is necessary to clarify this issue, given the use of fisheries resources in the Uruguay River.

A22. Issue: Effluent color and pH

Comments: The CIS makes the statement (page 15) "Emissions of colored substances may affect aquatic ecosystems through decreased transparency of water". In the discussion of wastewater impacts on the receiving environment, no mention is made of color and its potential impact on the Uruguay River ecosystem. Similarly, no mention is made of pH 'in the receiving environment' as a result of wastewater discharges from the two pulp mill facilities.

Recommendations: A thorough review and assessment of effluent color and its relationship to the receiving environment of the Uruguay River should be included in the CIS. In addition, pH in the receiving environment should be addressed.

A23. Issue: Mill site selection

Comments: The CIS does not provide a clear understanding of the site selection process employed by Orion and CMB. Many stakeholders have commented on this oversight. There is a desire on the part of stakeholders to have an unambiguous 'roadmap' of the decision process that governed elimination/selection of potential mill sites.

Recommendations: Both mills should outline the detailed rationale and 'decision tree' used when scrutinizing a given site for acceptance as a pulp mill location.

B. CIS/MILLS OPERATIONAL

B1. Issue: Monitoring of wastewater effluent discharges in the receiving environment

Comments: Wastewater discharges from pulp mills have created concern for receiving environment water quality and biological resources. Stakeholders have expressed concerns regarding the effect of both mill discharges on the Uruguay River. In order to address these, it is advisable that both Orion and CMB commit to a comprehensive effluent monitoring program, and provide more details on such a program than presently exists in the draft CIS.

Recommendations: The river monitoring program recommended should be comparable to that presently legislated in Canada (refer to Annex 3 for an overview of Canada's pulp and paper Environmental Effects Monitoring program). The investigative approach in Canada addresses study design, plume delineation, and the monitoring of fish and their usability, benthic invertebrate communities, physical and chemical nature of the receiving environment, and effluent toxicity. Technical Guidance for a pulp mill monitoring program may be reviewed at: http://www.ec.gc.ca/EEM/English/PulpPaper/Guidance/default.cfm. Given the relatively close proximity of the two mills on the Uruguay River, a cost-sharing plan could be developed wherein a design for fish programs, for example, may involve both mills, thereby resulting in a cost-saving for individual mills. This approach has functioned well in Canada, where we have developed programs of cost sharing for four different mills situated on the same river system. This approach would maximize the information return for resources expended. The Canadian model has experienced extensive testing and fine-tuning. These programs have been implemented across Canada for over 150 pulp and

paper mill operations. Taking advantage of Canada's experience would definitely serve to benefit any program on the Uruguay River.

B2. Issue: Air monitoring

Comments: Air quality has historically been a concern to locals inhabiting regions near pulp mills. The documenting of both stack and ambient conditions is critical for effective control of atmospheric emissions. A detailed air-monitoring program is required to maintain a knowledge base on regional air quality, and assist in the control of industrial emissions. This issue is of such concern to locals that it warrants being presented in the CIS in greater detail than exists at present.

Recommendations: Both Orion and CMB should commit to a comprehensive air-monitoring program commencing six months prior to mill start up. The following variables, for example, should be monitored from the appropriate stacks/locations (e.g., lime kiln, power boiler, recovery boiler, etc.): TRS, PM_{10}, $PM_{2.5}$, SO_x, NO_x, dioxins/furans, PAHs, and PCBs. These variables should be included for initial monitoring programs in order to determine the emission profile. Ambient air monitoring stations should be established in the vicinity targeting the following variables: TRS, PM_{10}, $PM_{2.5}$, SO_x, NO_x, PCBs, PAHs, and dioxins/furans. It is also recommended that if, following successive air monitoring runs on mill operations, non-detectible levels of, for example, PCBs, PAHs and dioxins/furans are determined, these could be eliminated from both monitoring programs (i.e., mill operations and ambient air).

B3. Issue: Confirmation studies on plume modeling

Comments: During the detailed design phase of the two pulp mills, it has been recommended above that effluent plume modeling studies be considered mandatory for both facilities. Given the issue of effluent dispersion and the target of maximizing dilution, an effective diffuser design is required. A pre-operational modeling exercise will facilitate this end.

Recommendations: During mill operations, dye/tracer studies should be implemented to corroborate the mixing and dilution characteristics of the initial modeling exercise. Effectively, tracer studies would provide quantification on plume behaviour which is critical for planning any effluent monitoring program in the Uruguay River. This program would assist in defining the near-field and far-field effluent exposure areas of the river that could ultimately be selected for long term monitoring purposes. If any issues arise over unforseen concentrations of effluent in the river, these data would serve as a basis for improving effluent characteristics and/or the outfall system.

B4. Issue: Toxicity-free effluent

Comments: On page 97 of the Botnia EIA there is a statement that they will produce a "…toxicity-free effluent…". The performance of bioassay tests on local fish species is critical if this statement is to be supported quantitatively.

Recommendations: The implementation of bioassay tests for both Orion and CMB effluents is recommended. If such tests do not exist in the region, protocols should be

developed in order to undertake such tests on mill effluents. Acute and chronic tests should be implemented on final effluents.

B5. Issue: Health impacts

Comments: There is widespread concern about health impacts of living near mills. There are approximately 300 bleached Kraft mills in the world, many of which discharge greater quantities of pollutants than the two proposed mills. In the 1970s and 1980s there were over 200 bleached Kraft mills operating in the world, all of which (except perhaps a few very small facilities) discharged MUCH higher quantities of pollutants than the proposed mills at Fray Bentos. The existence, or absence, of known health impacts would shed light on the current situation. It is neither sufficient nor feasible to assess the impacts of the total discharges on only a chemical or biochemical basis, however it is feasible to review past studies on the impacts on health of living near mills. Much of this will probably have to focus on the absence of reports of negative health effects in communities in the vicinity of mills. It should also describe towns where bleached Kraft mills have existed successfully for many years. There are many in Finland, and the main body of Europe. In the US there are many mill towns where mill discharges are much higher than will occur near Fray Bentos.

Recommendations: Health impacts of living within 40 km of pulp mills should be discussed in the final CIS. If no impacts have been found around mills with comparable, or higher, emissions than the two mills proposed, then this should be discussed and supported.

B6. Issue: Health standards for sulfur dioxide

Comments: Third parties have complained that since the draft CIS (page 44) shows SO_2 concentration as 72% of a health standard, there is a high risk that the standard will be exceeded on occasion. Other predicted concentrations are under approximately 10% of other health standards. This is because an Indian standard much lower than others in the world is referenced.

Recommendations: This unusually low standard referred to should be verified, and if accurate, it should be discussed in the final CIS.

B7. Issue: Regional energy balance

Comments: There is no discussion of the impact of the mills on the regional energy balance. The two mills will produce more electricity than they use, by burning biomass (black liquor is a biomass fuel since its organic content is derived entirely from wood), which is greenhouse gas neutral, and is obtained entirely from local, sustainable and renewable forests. Only the net emissions from the changes in power generation practices in the area should be attributed to the proposed mills.

Recommendations: Any impact of making this power available to the Uruguayan electrical power grid on emissions from fossil fuel fired power pants should be quantified in the final CIS.

B8. Issue: Wood waste incineration

Comments: There is no discussion of the impact of the mills on the regional wood waste balance. It seems from documents available that the CMB mill may be collecting and burning wood waste that is presently incinerated in low-technology burners or landfilled. If there will be such an impact, it should be discussed and quantified. Only the net emissions from the changes in incineration practices in the area should be attributed to the proposed mills.

Recommendations: The final CIS should analyze the impact of the proposed mills on the emissions from burning wood waste, not only from the mills, but also from current wood waste burning in the area.

B9. Issue: Treatment of Fray Bentos municipal sewage

Comments: There has been discussion of treating Fray Bentos municipal sewage in the Orion mill effluent treatment plant.

Recommendations: The environmental balance of this action is almost certain to be positive. It should be discussed in the final CIS.

B10. Issue: Effluent and atmospheric discharges in a local context

1. **Comments:** The draft CIS does not provide information for third parties to relate the discharges from the proposed mills to the current situation. It would assist the public to reach informed conclusions regarding the mills if the CIS were to present a brief inventory of other effluent discharges and atmospheric emissions, on both sides of the Rio Uruguay. It would be useful to compare the extent of likely odor perception around the mills with existing industries and agricultural operations in the region. The prediction of concentrations of atmospheric pollutants should consider existing ambient conditions.

   Recommendations: The final CIS should discuss impacts of atmospheric discharges around recently built bleached Kraft mills in Latin America, and also well established mills in Europe, specifically where communities are close to a mill, and tourism is active at distances under 40 km.

2. **Comments:** Under the "water quality" heading on page (vii) the draft CIS states "Discharged effluents will be diluted to undetectable limits [sic] a short distance of the discharge points of both plants". This is inaccurate, and detracts from the credibility of the CIS. Many of the pollutants will be detectable, although not necessarily at harmful concentrations (probably none at harmful concentrations).

   Recommendations: The final CIS should avoid such sweeping and inaccurate statements.

B11. Issue: Effluent and atmospheric emission limits

1. **Comments:** Many opponents of the mill projects have expressed concerns that even if the mills are built in an environmentally sound manner, they may not be operated

sufficiently well in the long term to avoid environmental damage. Limitations on discharges of effluent and on emissions to the atmosphere are an essential component of environmental protection in the context of pulp mills. These are most often set and controlled by government regulatory agencies, however there may be contractual limits where the mill management undertakes to respect certain limits as conditions of financing, remaining in operation or retaining customers. An effective monitoring and reporting program for emissions and discharges serves as a tool for operators in optimizing the process - a supervisory control tool for mill management. It also serves to inform the public and government agencies of the mill's environmental performance.

Recommendations: The final CIS should describe how the mill discharges and controls will be monitored by the Uruguayan regulatory authorities, and how this will relate to the combined control of the Rio Uruguay by the governments of Argentina and Uruguay. A program for providing the general public with timely data on emissions and discharges should be described.

2. **Comments:** The proposed limitations on mill discharges/emissions are not sufficiently comprehensive to ensure environmentally optimal design and continuing operation of the plant.

   Recommendations: The final CIS, or associated documents, should define limitations on discharges of effluents and atmospheric emissions for a sufficient number of the parameters, discussed in IPPC (2001), concerning bleached Kraft pulp mills to ensure optimal design and operation. The discussion should address all parameters mentioned by IPPC, and justify the inclusion or omission of each from parameters to be limited. Specifically numeric limitations on dioxin and furan discharges should be included. (In many cases, limiting one parameter effectively limits several others, due to the laws of physics and the practicalities of pulp mill design and operation. There is no justification for excessive limitations, which may be unenforceable or simply divert resources from the key issues.)

3. **Comments:** The proposed discharge levels of most parameters mentioned in the two companies EIA reports are substantially above the lowest values attainable by a mill built today that uses BAT.

   Recommendations: The final CIS should propose limitations for the selected environmental discharge parameters that reflect (at least) the lower values of the range mentioned in IPPC (2001) and also the values respected by the most advanced bleached Kraft mills in Latin America and Europe. The discussion should also consider the performance of the Alberta Pacific mill in Alberta, Canada. The limitations should refer to maximum daily discharges, and also to either maximum annual or monthly averages.

B12. Issues: Continuous monitoring of environmental parameters

Comments: Both mill EIAs included programs for continuous monitoring of certain environmental parameters. These are fairly comprehensive, however not complete. Certain environmentally significant variables can readily be monitored continuously by modern instrumentation, but the draft CIS does not address this fully. Some are

pollutants, while others serve to confirm that the production and environmental protection processes are operating normally and provide rapid warnings when it is not, so that corrective action can be taken in a timely fashion. If the gases from the dissolving tank vents are incinerated in the recovery boiler, then no monitoring is required. It would be appropriate to monitor certain equipment operating variables that provide information to regulators, mill management and the public on how reliably, or otherwise, the environmental protection systems are operating. The TRS vent stacks should be monitored whether in use or not. It may be reasonable to monitor the use/inactive status continuously, and periodically test while in use.

Recommendations: The final CIS, perhaps by reference to revised EIA reports by the two companies, should define a program for continuous monitoring and reporting of select environmental parameters. These should include all variables and discharge points listed in Table 2. The developers of the program should consult with DINAMA, IFC and any organization recommended by IFC. The program should correspond to information included in IPPC (2001).

Table 2 Environmental variables that may be monitored continuously.

Variable	Recovery boiler	Smelt dissolving tank vent	Biomass boiler	Lime kiln	TRS vent stacks and standby incinerators	Effluent discharge
Particulates	X	X	X	X		
SO_2	X		X	X		
TRS (or total S)	X	X		X	X	
Opacity	X	X	X	X		
NO_x	X		X	X		
Carbon monoxide	X		X			
Flow						X
Conductivity						X
pH						X
Temperature						X

This table is a preliminary recommendation. The final CIS should include comparable information, with justification for variables and monitoring points selected, and considering the design features of each mill.

B13. Issue: Regular monitoring of effluents

Comments: The monitoring program proposed in the Orion EIA for variables to be determined discontinuously in mill effluents is inadequate for the purposed mentioned above. It refers largely to performing analyses weekly to determine key variables of effluent discharges, whereas daily analyses of many are necessary for effective control of effluent quality. The program proposed in the CMB EIA is more comprehensive, and envisages daily testing of most of the key variables.

Recommendations: The final CIS, perhaps by reference to revised EIA reports, should define a program for regular monitoring and reporting of selected characteristics of the treated effluent. These should include all parameters and discharge pointed listed in

Table 3. The developers on the program should consult with DINAMA, IFC and any organization recommended by IFC. The program should be based on information included in IPPC (2001), adapted to local circumstances.

Table 3 Effluent variables that may be monitored regularly.

Variable	Daily	Weekly	Monthly	Monthly (until plant performance proven)	Annually
COD	X				
BOD		X			
Suspended solids	X				
AOX	X				
Color	X				
Phosphorus		X			
Nitrogen		X			
Mercury				X	X
Toxicity			X		
Dioxins and furans				X	X

This table is a preliminary recommendation. The final CIS should include comparable information, with justification for variables and monitoring frequency selected.

There are several standardized test procedures used around the world for the variables mentioned in Table 3, except for toxicity. The proposed program should define the test methods with due consideration to standards used in Uruguay, and the practicality of having reliable testing performed there with corroborating testing by local, independent laboratories.

Referring to toxicity in Table 3, there is no widely recognized standard. The program proposed in the final CIS should consider that Canada has the most extensive experience in testing pulp mill effluent for toxicity, but also that conditions in the Rio Uruguay are different from those prevalent in Canada.

B14. Issue: Public access to information on mill discharges

Comments: The public has expressed concerns regarding the danger of mills failing to maintain discharges to low levels. The Botnia EIA mentions making some of the data collected during environmental monitoring accessible to the public, primarily data on ambient conditions.

Recommendations: The final CIS should include a program for making environmental data available to the public, both in real time on the Internet and by means of monthly reports issued by the mills, with verification by DINAMA or other competent authority.

B15. Issue: Operating procedures and training

Comments: Several comments from third parties express concern that if the mills are built, their operations will not be sufficiently well controlled to protect the environment, even if the mill design and equipment are excellent. A high level of operator training and excellent operating procedures are essential components of BAT. It is common for mills to operate successfully in regions where few skilled people are immediately available, by implementing a planned training and education program.

Recommendations: The final CIS should analyze the company plans for hiring, and training skilled operators, operating supervisors and the necessary engineering and technical support staff.

C. ISSUES RELATED TO ENVIRONMENTAL IMPACT ASSESSMENT REPORTS

The Environmental Impact Assessment (EIA) reports issued by Orion and CMB were the basis for much of the CIS. These do not provide sufficient information on the mills for the public to reach an informed decision whether to support or oppose the mill installations, or for a thorough CIS to be prepared. On the basis of the track record in environmental protection of the two companies, knowledge of modern pulp industry equipment and design practices, the Expert Panel suspects that many of the apparent deficiencies in the mills are primarily a matter of lack of adequate information and public commitment by the two companies, rather than environmentally deficient design. However more complete and reliable information is necessary for stakeholders outside Botnia and ENCE to form reasonable opinions on the projects.

The following issues are primarily related to the EIA reports, and will, of course, impact the CIS and the reaction of stakeholders to the proposed mills.

C1. Issue: Recycling alkaline effluent from the bleach plant

Comments: Recycling of the alkaline effluent streams from the bleach plant to the pulping/chemical-recovery systems is defined as part of BAT, however this process is not included in the designs of the proposed mills. The process variation involves recycling the alkaline bleach plant filtrates to wash the unbleached pulp, so that most of the organic material discarded in the alkaline bleach stages (at least 50% of total bleach wastes) is incinerated in the recovery boiler. This will substantially improve almost all effluent parameters, including flow, BOD, COD, color, dioxins and furans.

Recommendations: The final CIS should discuss the pros and cons of recycling alkaline bleach plant effluent, and the companies either adopt the technique, or an equally effective alternative, or justify omitting this feature of BAT from the mill design.

C2. Issue: BAT and Eucalyptus pulp mills

Comments The IPPC BREF was written in the European context, where Eucalyptus is used much less than softwoods and northern hardwoods. One widely recognized feature of Eucalyptus pulp mills is that the organic pollutants in the mill effluents generated are more readily biodegradable than any of the other species widely used for pulp manufacturing (Aspen, or poplar, used in North America is somewhat similar). Some of

the comments from the public imply that they are concerned that effluent from pulping Eucalyptus will be more polluting than those from the pulp industry in general. Because of this, one can expect that discharges of BOD, COD and color from Eucalyptus mills using systems based on BAT will be at the low end of the ranges defined by IPPC (2001), or even lower. This is not evident in the draft CIS or the company EIAs.

Recommendations: It is recommended that the significance of Eucalyptus as a raw material for pulp manufacture be discussed in the final CIS, including reference to the effluent discharges from advanced Brazilian mills including at least Veracel, Riocell, Aracruz and Bahia Sul. These mills are from two to twenty-five years old, and use systems and operating techniques generally similar to BAT. If the proposed Uruguayan mills are not going to be constructed to at least equal their environmental performance, this should be justified in the CIS and/or EIAs.

C3. Issue: Incineration of High-Volume Low-Concentration non-condensable gases (HVLC)

Comments: Both mills indicate that low-concentration non-condensable (malodorous) gases from the black liquor system will be collected and incinerated, but are perhaps not incinerating all such gases. There are many sources of such gases in a Kraft mill, and it is not clear whether **all** will be collected. Omission of some of these streams has caused serious odor problems in otherwise well built mills in the past.

Recommendations: The scope of the systems should be defined clearly in the CIS perhaps by reference to appropriately revised EIA's, including a list of sources to be treated.

C4. Issue: Oxygen delignification

Comments: IPPC suggest that multi stage oxygen delignification is an essential component of BAT. Single stage may be adequate for optimal environmental performance in these mills, since they process Eucalyptus.

Recommendations: Company EIAs should discuss, and justify their choice of process.

C5. Issue: ECF bleaching with low AOX

Comments: One feature of BAT is the use of "low-AOX" ECF bleaching. Both bleach plants appear to use approximately 15 kg chlorine dioxide/t pulp. Values below 10 kg/t chlorine dioxide are realistic, and would reduce AOX and probably color, dioxin and furan discharges. Older practice in the pulp industry is to discuss chlorine dioxide usage in terms of "equivalent chlorine" where one kg chlorine dioxide is considered equivalent in bleaching power to 2.63 kg of elemental chorine. This is considered to be outdated terminology, but mentions it here to minimize any confusion. Whenever quantities of chlorine dioxide are mentioned herein, they refer to the actual chemical, ClO_2.

Recommendations: The final CIS should discuss the appropriate amount of chlorine dioxide to use in each mill.

C6. Issue: "Low odor" design recovery boiler

Comments: Some third party comments have expressed concerns about odor emitted from the mill's black liquor recovery boilers. The draft CIS describes the mills as using "low-odor" boilers. The term "low-odor" boiler is used in the US to define a Kraft recovery boiler without a direct contact evaporator. These boilers are rarely used outside North America, and none have been built since about 1990. It is mentioned here only because the draft CIS mentions it.

Recommendations: Both mill EIAs should make it clear that only the "low-odor" boiler is being considered.

C7. Issue: Tanks to contain spills

Comments: Adequate tanks for storage of spilled cooking and recovery liquors and dirty condensates to prevent peaks of loading in the effluent treatment plant are required in any mill that is to operate to BAT levels of environmental performance.

Recommendations: Selection of "adequate" volumes of tanks within the mill must be left to the detail designers, however the final CIS should discuss this issue, and the companies could make narrative commitments to have adequate tankage.

C8. Issue: Biological effluent treatment

Comments: An efficient biological effluent treatment system is a key feature of BAT. Many critics of the mills question whether effective effluent treatment will be installed. Biological treatment systems are often referred to as "secondary" effluent treatment systems in the literature. Both mill EIA's make it clear that they intend to install such system, using the conventional activated sludge treatment process. This is a very old process, with over 100 years of operating experience, however in its modern version, it is still appropriate to a state-of-the-art Kraft pulp mill. The companies provide little information on the principal design characteristics of the systems they propose. Some of the necessary data are included in the Orion EIA, and, to the extent that it is there, indicates a BAT level system. However it is incomplete. Both EIAs indicate annual average performance of their secondary treatment systems, which are far removed from the best currently operating, or from the lower range of the BAT definition. These values should be updated, and compared in the final CIS to the best plants running in the EU, Latin America and North America.

Recommendations: The following factors should be specified by the companies, and analyzed in the final CIS:

1. Design flow, normal and peak;
2. Aeration tank volume, and number of tanks;
3. Aeration type and power to be installed;
4. Size and number of secondary clarifiers; and

5. Expected discharge of BOD, COD, suspended solids, Nitrogen, phosphorus, color, dioxins/furans, AOX. Both annual averages and peak, or 99th percentile, values should be specified.

C9. Issue: Life of plants *vs.* Landfills

Comments: The life of the plants is estimated at 40 years, however the description of landfill provisions does not extend beyond 20 years.

Recommendations: This inconsistency should be addressed or eliminated in the final CIS and/or EIA's.

C10. Issue: BAT in 2006 – Effluent flows

Comments: The two mills have estimate effluent discharge flows at 25 to 30 m^3/t pulp produced. Lower flows are technically feasible, and perhaps desirable. IPPC (2001) states that effluent discharge flows are in the range of 30 to 50 m^3/t in mills using BAT. However, consideration of the water balance presented by Orion, and referring to experience in recent mills, 20 m^3/t is a more realistic value today. Total water use is of no environmental importance by itself when the supply is so abundant as the Rio Uruguay. The reason that reducing flows is important is that biological treatment plants can be operated to lower discharge rates of BOD and suspended solids if the effluent flow is low. One obstacle to reducing flow of effluent from mills is that some effluent control regulations are expressed as concentrations. This is a disincentive to mill owners to reduce effluent flows, and should be addressed in the final CIS.

Recommendations:

1. Regulators should avoid specifying limits on concentrations of pollutants in mill effluents, but should impose limits based on mass of pollutants discharged.

2. The companies should justify the relatively high effluent flows, or undertake to reduce them to below 20 m^3/t

C11. Issue: BAT in 2006 – Partial replacement of chlorine dioxide

Comments: IPPC (2001) mentions the possibility of replacing some of the chlorine dioxide used in conventional ECF bleaching with ozone or pressurized hydrogen peroxide. The proposed mills plan to use 15 kg chlorine dioxide/t product. Today, there are a number of such systems in operation, using lower quantities of chlorine dioxide.

Recommendations: The companies should undertake to reduce use of chlorine dioxide to below 10 kg/t pulp, or justify not doing so. The final CIS should address this issue.

C12. Issue: Overly conservative estimates of discharges

Comments: In some cases, estimates of discharges appear to be extremely conservative. For example, the predicted AOX discharge of 0.15 kg/t of product is well above the average values of 0.04 kg/t reported by the Alberta Pacific mill in Boyle, Alberta, Canada, which uses similar technology to the two mills under discussion. This same mill discharges only 0.1 kg/t BOD, and 7.2 kg/t COD. Several mills in Latin America

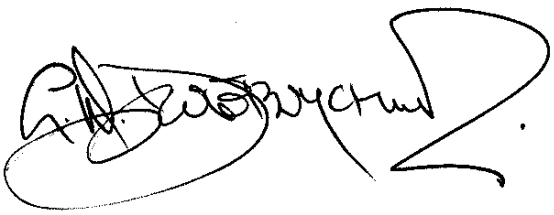
demonstrate comparable performance. While it is desirable that predictions of discharges from mills used for EIA should be conservative, an excessive degree of conservatism leads to wasted resources in the analysis of the project, and leads to unnecessary concern on the part of third parties.

Recommendations: The mill developers should review their predictions of effluent and atmospheric discharges.

During the course of reviewing documents, a number of people were contacted in order to obtain their opinions regarding specific issues; these included Dr. Kelly Munkittrick (University of New Brunswick; fisheries); Mr. Tibor Kovacs (Pulp and Paper Research Institute of Canada; dioxins in pulp mill effluent); Dr. Jim Stronach (Consultant; effluent plume delineation modeling); Mr. Lanny Harris (Consultant; chemical/process engineering); Mr. Bob McFarland (Consultant; forestry/plantations); and Mr. Al Lanfranco (Consultant; air quality monitoring).

Appropriate consideration and coverage of the points raised will clarify and enhance specific issues related to the two pulp mills on the Uruguay River. In a more global context, it is recommended that the IFC, or the individual companies, provide complete responses to stakeholders who have taken the time to submit comments regarding the two EIAs, and other related matters (e.g., adherence to IFC/World Bank protocols).

Yours sincerely,



L. Wayne Dwernychuk, Ph.D., R.P.Bio.
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HATFIELD CONSULTANTS LTD.

Encl. (3)

Reference cited:

IPPC 2001. Integrated Pollution Prevention and Control (IPPC) Reference Document on Best Available Techniques in the Pulp and Paper Industry. Published in 2001 by the European Union Commission. Frequently referred to as the "BREF" in the context of discussion of the pulp industry.

ANNEX 1

Cumulative Impact Study on Uruguayan Pulp Mills – Comment Submissions

Cumulative Impact Study on Uruguayan Pulp Mills
Comment Submissions

Date	Subject	Name	Country	Organization
01/24/2006	Papeleras en Fray Bentos	ceccarelli alejandro	Canada	opinion personal
01/24/2006	Re:Are politicians really supporting the will of the people?	Gurovich Sebastian	Australia	Research School Of Astronomy and Astrophysics
01/24/2006	instalaci n de las plantas de celulosa en Uruguay	V zquez Clavijo Mar a del Carmen	Uruguay	NINGUNA
01/24/2006	Plantas de pasta celulósica en Uruguay	Ravera Dario	Argentina	citizen of the world...
01/25/2006	RAZONES PARA DENEGAR EL CREDITO	Bourlot Eugenio	Argentina	CIUDADANO de Gualeguaychu, PADRE DE 2 HIJOS
01/25/2006	Antecedentes recientes de daños en sistemas bioambientales del uso de la tecnología ECF en Chile. Informe de la WWW Foundation	Falivene Graciela Mónica	Argentina	Cátedra de Planeamiento , Facultad de Arquitectura Universidad de Concepción del Uruguay
01/25/2006	FERMENTACION DE L A MADERA CHIIPIADA	Thomasset Baister Carlos Walter	Uruguay	Asesor Técnico Industrial
01/26/2006	opinion	Basaldúa Estefania	Argentina	habitante de Gualeguyachu
01/27/2006	Papeleras sobre el Rio Uruguay	Pereyra Norberto	Argentina	CENT Nro 22
01/28/2006	ref	BONNET CARLOS FABIAN	Argentina	UNER
01/29/2006	Estudios de impacto ambiental	Gomez Lorena	Argentina	Independiente
01/29/2006	Basta de mentiras, no a la contaminación ambiental	Veleiro Marta	Argentina	ciudadana de Gualguaychú
01/30/2006	residuos contaminantes?	MONTAÑO MARIA ELENA	Argentina	ninguna
01/31/2006	EL MOVIMIENTO DEL RIO URUGUAY.	Rivas Andres	Argentina	NInguna
01/31/2006	¡ SÍ a las papeleras !	García Carlos	Uruguay	opinión personal
02/01/2006	Implantación de papeleras en el Uruguay (ENCE)	rivas vilas luis miguel	Spain	fia-ugt
02/03/2006	Plantas de Celulosa	A.C.F Partido Nacional	Uruguay	Política
02/03/2006	EL MOVIMIENTO DEL RIO URUGUAY.	traba jose	Argentina	asamblea ambiental ciudadana
02/05/2006	Plantas de Celulosa	Villaverde Alejandro	Uruguay	Online Solutions
02/06/2006	No a la construcción de las papeleras	Parisi Fernando	Argentina	Ciudadano

02/06/2006	Informe Técnico de la Cancillería Argentina	Falivene Graciela	Argentina	Universidad de Concepción del uruguay, Entre Ríos Argentina
02/07/2006	Contaminación de aguas	Falcomer Santiago	Argentina	Particular
02/07/2006	instalacion de las Papeleras sobre el rio Uruguay	Verde Luis	Argentina	Independiente
02/07/2006	financiacion plantas papeleras	katez julio	Argentina	ninguna
02/08/2006	Planta de Celulosa - Blanqueo ECF	HURTADO JOSE MARIA	Argentina	MAISUR S.A. - MAI CONSULTING GROUP
02/08/2006	seamos honestos	Otero María	Uruguay	ninguna
02/09/2006	RAZONES HAY MILES - RIOS LIMPIOS - AMBIENTES SANOS	Guruciaga Norberto	Argentina	Particular
02/10/2006	PAPELERAS	LEONARDO DANIEL NAHUEL	Argentina	PARTICULAR
02/10/2006	Solución para el conflicto sobre el rio Uruguay	Baldoni Oscar Armando	Brazil	Baldoni, Ind.Com,Imp.,Exp. Ltda.
02/10/2006	Sobre las pasteras que estan construyendo sbre la orilla del rio Uruguay	Borchi Alrjandro	Argentina	Ninguna
02/12/2006	Plantas de Celulosa en Fray Bentos, Dpto. Río Negro/URUGUAY	Font Guillermo	Uruguay	vecinet
02/12/2006	Plantas de Celulosa en Fray Bentos, Dpto. Río Negro/URUGUAY	Font Guillermo	Uruguay	vecinet
02/12/2006	Opiniones del Gobierno uruguayo	Font Guillermo	Uruguay	vecinet
02/12/2006	Mecanismos de Desarrollo Limpio y Financiación a papeleras....coherencia???	palazzo romina	Argentina	particular
02/14/2006	El factor ESCALA en la cuestión de la contaminación	Florio Mariano	Argentina	Independiente
02/15/2006	CEDHA Compliance Complaint to CIS	Taillant Jorge Daniel	Argentina	CEDHA
02/15/2006	Plantas de celulosa en Uruguay	Honty Gerardo	Uruguay	Red Uruguaya de ONGs Ambientalistas
02/15/2006	Impact Study - Financiamiento IFC org	Godoy Fèlix	Argentina	Independiente
02/15/2006	Preguntas varias y Baltic Pulp	Simoncelli Miguel	Uruguay	ciudadano comun
02/16/2006	No a la contaminacion binacional	Mariezcurrena Virginia	Burkina Faso	SNV
02/16/2006	Impact Study of Mills in Uruguay - Sejenovich - Univ. Buenos Aires	Sejenovich Sergio	Argentina	Universidad de Buenos Aires

02/16/2006	CIS - Comentarios Grupo Guayubira Uruguay	Perez Teresa	Uruguay	Grupo Guayubira
02/16/2006	CIS : Grupo Guayubira URUGUAY	Perez Teresa	Uruguay	Grupo Guayubira
02/16/2006	CIS - Grupo Guayubira	Perez Teresa	Uruguay	Grupo Guayubira
02/16/2006	NO A LAS PAPELERAS	Bayo Fernanda	Argentina	Asamblea Ciudadana Ambiental de Gualeguaychú
02/17/2006	COMENTARIOS SOBRE LA REUNION PUBLICA DEL 14/02/2006.	RUSSELL HORACIO	Uruguay	FACULTAD DE CIENCIAS AGRARIAS
02/17/2006	Contaminar o no contaminar esa es la cuestión	Perlini Montiel Alcira Noemí	Argentina	Fundación Argentina de Etoecología - FAE -
02/17/2006	Comentarios al Borrador del CIS del IFC	Brufman Paula	Argentina	Greenpeace
02/17/2006	Proceso de Conuslta de Borrador de Estudio de Impactos Acumulativos de las plantasde celulosa de Uruguay	Sabsay Daniel Alberto	Argentina	Fundacion Ambiente y Recursos Naturales
02/17/2006	Documentos de CIS y reunión en Punta Carrasco	Rodríguez Tourón Gastón	Argentina	Asociación Civil Tierra XXI - Red de la Ribera

Additional Comments Submitted Directly to IFC Representatives				
Date	**Subject**	**Name**	**Country**	**Organization**
09/2005	Preliminary Report: Paper Mills on the Uruguay River	Chair of Hydraulic Works and Chair of Environmental Engineering	Argentina	Universidad Nacional de Córdoba
02/14/2006	Transcripción de la Reunión Publica referente al Estudio de Impactos Acumulativos de las Plantas de Celulosa Uruguayas	--	Uruguay	--
02/14/2006	Comentarios al Borrador del CIS del IFC	--	Uruguay	Comisión Multisectorial
02/14/2006	El Mensaje de la Med. Vet. Maria Carolina Grosso, UNRC	--	Uruguay	Red de la Ribera
02/14/2006	Exigimos al BM, IFC y MIGA un comportamiento respetuoso y serio	Luis Castrillón	Uruguay	Movitdes
02/16/2006	Transcripción de la Reunión Publica referente al Estudio de Impactos Acumulativos de las Plantas de Celulosa Uruguayas	--	Argentina	--
02/16/2006	Comentarios al Borrador del CIS del IFC	Dr. Santiago Royas	Argentina	Universidad Nacional de Córdoba
02/16/2006	Comentarios al Borrador del CIS del IFC	Dr. Raúl A. Montenegro	Argentina	FUNAM

ANNEX 2

Best Available Techniques (BAT)

BEST AVAILABLE TECHNIQUES (BAT)

Much of the discussion around the design and operation of the two proposed mills centers on "BAT"; it is discussed below in general terms.

1.0 DEFINITIONS AND CONCEPTS

While the short English phrase "Best Available Techniques" (BAT) seems simple. Determining whether BAT is, or will be, used in a pulp mill is not simple.

For a bleached kraft mill, BAT involves:

- The best process design for minimizing pollutant discharge, while achieving the product quality necessary for the market;
- Ensuring that equipment specifications based on the process design include adequate capacity to recover as much of the polluting waste generated as possible;
- Installing the best equipment to implement the above process design;
- Installing effluent treatment system(s) and air pollution control devices to remove the pollutants that are discharged by the production equipment;
- Training operators and mill management to use the systems effectively and reliably;
- Maintaining the systems and operator skills to a high level; and
- Monitoring the operations, particularly discharges, to ensure that they are reliably maintained at optimal levels.

Items 1, 2, 3, 4 and 7 can and should be clearly determined before mill construction commences, at the level of mill approvals by the regulators. The associated features of the mill design (1, 2 3, & 4) can be defined in the EIA's, or other public documents. Item 7 can be addressed by a monitoring program, agreed to between the mills and the regulators, with enforceable commitments entered into to comply.

Items 5 and 6 can be discussed only in narrative terms before mill construction, and are elements of operations.

Concerning item 7, it is useful to define the extent to which the data will be available to the public, preferably in real-time, and the extent to which the companies monitoring will be monitored by an independent agency.

2.0 IPPC

The IPPC BREF (IPC 2001) lists the following measures as being essential aspects of a BAT mill design:

- Dry debarking of wood;
- Increased delignification before the bleach plant by extended or modified cooking and additional oxygen stages;
- Highly efficient brown stock washing and closed cycle brown stock screening;
- Elemental chlorine free (ECF) bleaching with low AOX or Totally Chlorine Free (TCF) bleaching;
- Recycling of some, mainly alkaline process water from the bleach plant;
- Effective spill monitoring, containment and recovery system;
- Stripping and reuse of the condensates from the evaporation plant;
- Sufficient capacity of the black liquor evaporation plant and the recovery boiler to cope with the additional liquor and dry solids load;
- Collection and reuse of clean cooling waters;
- Provision of sufficiently large buffer tanks for storage of spilled cooking and recovery liquors and dirty condensates to prevent sudden peaks of loading and occasional upsets in the external effluent treatment plant; and
- In addition to process-integrated measures, primary treatment and biological treatment is considered BAT for kraft pulp mills.

3.0 BAT IN THE USA

The term "BAT" is also widely used in USA in the context of environmental performance and regulations in the pulp and paper industry. US BAT is discussed by many writers around the world, since the US pulp industry is the largest, is well known, and the US EPA publishes widely. The EU choice of the same abbreviation for a different concept and set of environmental control criteria leads to confusion, particularly outside the US and EU. In most respects, the EU BAT is more stringent and comprehensive than the US one.

In the USA, "BAT" refers to "Best Available Technology". While similar in its purpose as a tool to control environmental impact of pulp and paper mills, its legal concept and technical level is quite different from BAT as discussed by IPPC. Unless otherwise stated explicitly, "BAT" herein refers to the European definition.

ANNEX 3

Overview of Canada's Environmental Effects Monitoring Program

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1 Introduction

This Guidance Document provides information on the recommended methodologies, which are based on generally accepted standards of good scientific practice, and options on how to carry out the Environmental Effects Monitoring (EEM) studies. Please note that this Guidance Document has been revised from the April 1998 version and is published in a format and is viewed as a document which can, and will, be updated regularly as new information and research becomes available. To ensure that the most recent updates are included in this document, consult our website at www.ec.gc.ca/eem, or contact Environment Canada's, National EEM Office (phone: 819-997-1535; fax 819-953-0461; e-mail: eem-esee@ec.gc.ca; website: http://www.ec.gc.ca/eem. The purpose of this introductory chapter is to provide the readers with a link between the terminology that is used in Sections 28, 29 and 30 and Schedule IV.1 of the *Regulations Amending the Pulp and Paper Effluent Regulations* (RAPPER) and what is used in this Guidance Document.

1.1 Regulatory Framework

In 1992, the *Pulp and Paper Effluent Regulations* (PPER) under the *Fisheries Act* replaced a 1971 pulp and paper regulation. The 1992 PPER set discharge limits for total suspended solids (TSS) and biochemical oxygen demand (BOD). As well, they set a requirement that all discharged effluents should be non-acutely lethal to rainbow trout in 100% effluent. Compliance with the PPER entailed major changes in a way effluents were treated by the industry, resulting (in most cases) in the installation of secondary (biological) treatment plants. Although it was acknowledged that more stringent discharge limits would improve environmental protection, it was also recognized that these measures alone might not ensure adequate protection of the aquatic ecosystem at every site. Consequently, the 1992 Regulations included the requirement for an Environmental Effects Monitoring (EEM) program.

On May 4, 2004, the R*egulations Amending the Pulp and Paper Effluent Regulations*, (RAPPER) came into force. The text of the PPER can be downloaded from http://laws.justice.gc.ca/en/F-14/index.html. Pulp mills in Canada that are subject to the RAPPER will continue to conduct EEM studies. For the most part, the EEM requirements from the "Aquatic Environmental Effects Monitoring Requirements (revised EPS/1/RM/18) and "Pulp and Paper Aquatic Environmental Effects Monitoring Requirements (Annex 1)" were integrated into Schedule IV.1 in drafting the revised regulations.

The National EEM Program requires Canada's pulp and paper mills to conduct studies on their receiving environments in order to assess and monitor effects potentially caused by their effluent. The structure of the EEM program ensures a certain level of national consistency in the way in which mills monitor the effects of their effluent on the environment. EEM's site-specific nature calls for iterative evaluations of the potential effects of effluent on fish, fish habitat, and the use of fisheries resources. The program is structured in a three to six years sequence monitoring and interpretation phases known as

"cycles". At the beginning of each cycle, each mill submits a site-specific study design to the authorization officers as identified in the regulations. By the end of each cycle, mills submit an interpretative report summarizing their field work and interpreting their results. EEM data is submitted in the electronic format provided by Environment Canada. To better facilitate the data entry for electronic reporting and submission, Environment Canada has developed a new Internet data entry system for EEM data submission. For more information on electronic reporting please see Chapter 8.

1.2 Background: The Evolution of the Pulp and Paper EEM Program and Guidance Document

Between 1992 and 2004, the pulp and paper industry has completed three cycles of monitoring and reporting. Cycle 1 was primarily used as a baseline to gain a better understanding of the variability of the field measurements. Although the methodologies developed for the EEM program were founded on good science and tested successfully in investigations outside of EEM, Cycle 1 was the first national-scale monitoring effort using the EEM monitoring approaches in Canada. As such, it was not surprising that a number of monitoring problems were identified after the end of the first EEM cycle. This led to an extensive government–industry review of Cycle 1 to identify the specific monitoring problems and to provide recommendations for improvements for the following cycles. "Decision trees" were developed to help guide mills, consultants, and Environment Canada's regional co-ordinators in determining site-specific study designs (e.g., fish species selection and selection of the reference area). A portion of the Cycle 1 review also included modifying the Technical Guidance Document (Environment Canada, 1998b) to provide mills and consultants with more detailed guidance on monitoring on a site-specific basis.

The technical and scientific review conducted on Cycle 1 provided recommendations to deal with issues leading to a vast improvement of Cycle 2 study designs and, consequently, more consistently good quality data. A scientific review and data assessment was completed by the department after each cycle. The second cycle review confirmed that the EEM program was working well and producing high quality data. The data also showed that mills have been successful in reducing the toxicity of their effluent and effluent quality has vastly improved since the 1992 PPER were promulgated, however effects on benthic invertebrates and fish remain. The National Assessment of cycle 2 EEM (Lowell *et al.*, 2003) data showed that pulp and paper mill effluents were affecting fish and fish habitat with the average national response pattern showing a combination of nutrient enrichment and impacts on fish reproduction. Future cycles of EEM will provide information on extent and magnitude of effects, temporal trends, and possible specific causes of the effects. For more information on Cycle 1 and 2 results, the National Assessment of the Pulp and Paper Environmental Effects Monitoring Data: (NWRI Contribution No. 03-521) and the Report Synopsis: (National Assessment of Pulp and Paper Environmental Effects Monitoring Data) are available at: http://www.ec.gc.ca/eem/. Please note the website will be updated shortly.

Experience gained through program implementation (i.e. completing the EEM field studies and analyzing data) will result in continuous improvements to the program. As well, external research initiatives conducted to respond to monitoring issues contribute to the development of new EEM methods. The recommendations presented in this document are based on the most recent information stemming from the review of the program and are meant to re-emphasize important recommendations in existing EEM guidance. Moreover, new information resulting from the major multistakeholder consultation that took place over recent years to develop an EEM program for the metal mining sector is integrated here. This information is being made available to mills and their consultants to help further improve study design development and the subsequent generation of scientifically defensible and interpretable data. In fact, many of the references recommended in this document direct EEM practitioners to the MM Guidance Document.

1.3 Program Overview

The objective of the Pulp and Paper EEM Program is to evaluate the effects of effluents on fish, fish habitat and the use of fisheries resources, which will be used to assess the adequacy of regulations on a site-specific basis. Information from a nationally consistent EEM program, along with social, economic, and technological information, can be used to assess the effectiveness of pollution prevention and control technologies, practices, programs, and indicate where there is a local, regional or national need for enhanced protection.

EEM is conducted in the aquatic receiving environment at locations where effluent is being deposited. An EEM study includes the following components:

- a fish population survey to assess the health of fish;
- a benthic invertebrate community survey to assess fish habitat;
- a study of dioxins and furans in edible fish tissue where dioxins and furans are present in the effluent as an assessment of the usability of fisheries resources;
- sublethal toxicity testing to assess effluent quality; and
- supporting water and sediment quality variables to aid in the interpretation of biological data.

Under the new regulations mills will conduct biological monitoring (survey on fish population and benthic invertebrate community, and a fish tissue study) every three years. The mills will also conduct sublethal toxicity testing on their effluents twice a year. Reduced frequency in EEM will apply under certain conditions.

As per standard methods of good scientific practice, a study design is developed that outlines the intention of the scientific study and the how the study will be conducted. The study design is submitted to the authorization officer at least six months of conducting the field monitoring. Once the study design is developed the field sampling is

conducted as per the study design, and the data from the study are assessed and reported on.

The guiding principles of the EEM program are that the program be scientifically defensible, cost-effective and provide flexibility for site-specific requirements, without subjecting field crews to unsafe sampling conditions. The program has also been designed to allow for incorporating new or improved monitoring techniques and to build on findings of relevant research programs or pilot studies. Furthermore, where there is more than one mill in close proximity, and effluents are discharged to the same drainage basin, joint EEM studies are encouraged.

EEM follows a tiered monitoring approach, with monitoring requirements of each cycle dependent upon results of the previous monitoring cycle. The program is designed to allow more extensive monitoring efforts where there are effluent related effects detected, and less monitoring where there are not. This feature of the program helps to ensure cost-effectiveness of the monitoring being conducted. The tiering of the EEM program is achieved by answering the following questions:

(1) is there an effect?
(2) has the effect been confirmed in two consecutive cycles?
(3) are the extent and magnitude of the effect known?
(4) Is the mill-related cause of the effect known?

Figure 1-1 shows how the answers to these questions determine the monitoring needs for the next monitoring cycle. Study needs, including frequency of monitoring, for each cycle can be determined using Figure 1-1. Each study conducted under EEM will be designed to answer one of the following questions. It is understood that at any time a mill may proceed to a more detailed level of study than recommended by Figure 1-1 should they desire (i.e., magnitude and geographical extent or investigation of cause).

1.3.1 Is there an effect?

The EEM program is designed first to determine if there is an effect in the receiving environment on fish, fish habitat or fisheries resources. For the purpose of this program, an effect is defined as an effect on fish, fish tissue or the benthic invertebrate community where:

- an “effect on the fish population” means a statistical difference between data related to indicators of fish growth, reproduction, condition and survival of a fish population taken in an exposure area and a reference area (e.g., control/impact design) or taken within the exposure area at stations that indicate gradually decreasing effluent concentrations (a gradient design). The indicators for the fish population survey are calculated using measurements of length, total body weight and age of the fish, liver or hepatopancreas weight and, if the fish are sexually mature, the egg weight, fecundity rate and gonad weight of the fish;

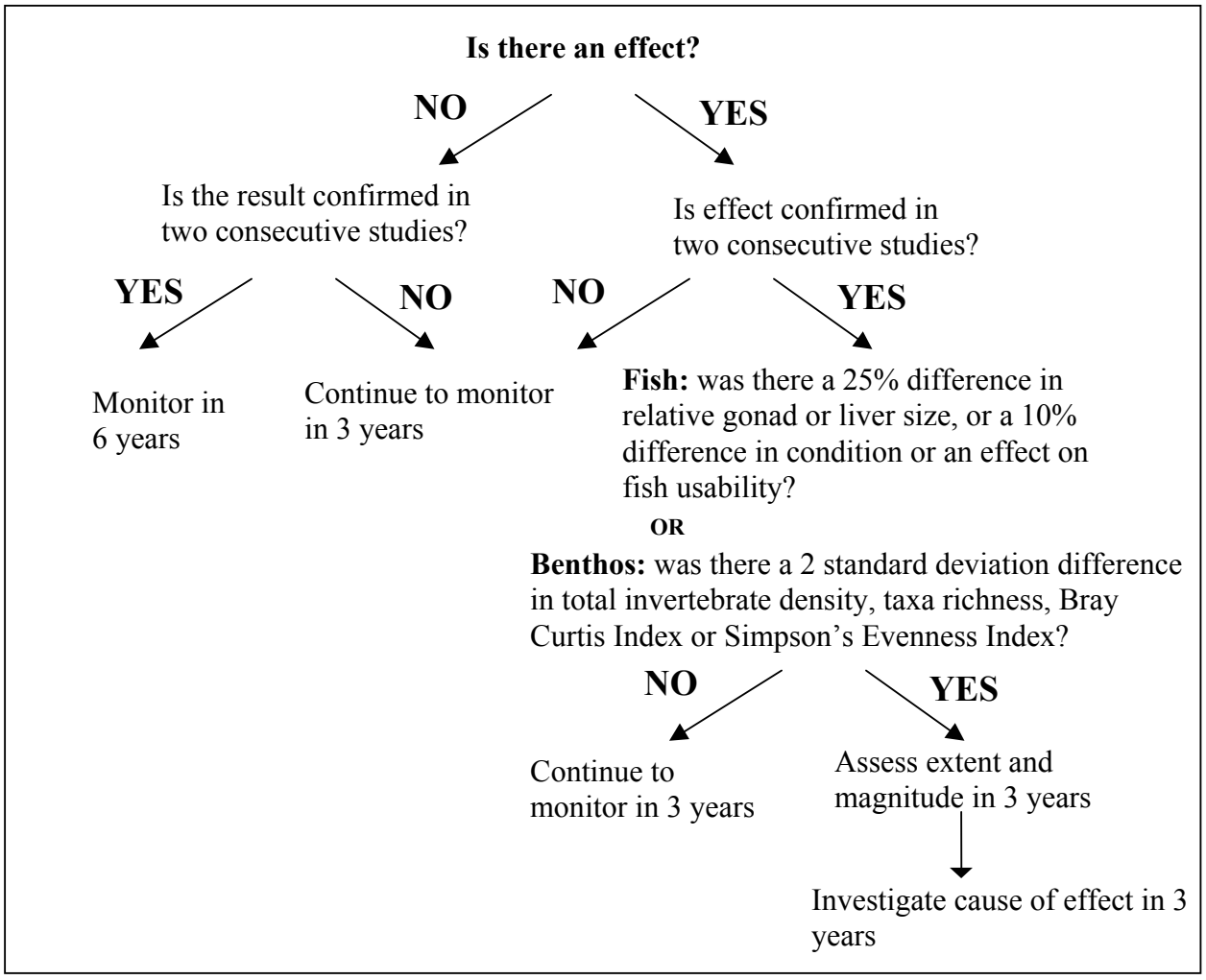
- an "effect on fish tissue" means that the concentration of chlorinated dioxins and furans, exceeds 15 pg/g wet weight in muscle or 30 pg/g wet weight in liver or hepatopancreas in fish taken in the exposure area (i.e. exceed Health Canada guidelines);

- an "effect on the benthic invertebrate community" means a statistical difference between benthic invertebrate community data taken in an exposure area and a reference area (e.g., control/impact design) or taken within the exposure area at stations that indicate gradually decreasing effluent concentrations (a gradient design). The data used to calculate effects on the benthic invertebrate community include the total benthic invertebrate density[1], evenness index (Simpson's evenness), the taxa richness, and Bray-Curtis index[2].

[1] The terms total invertebrate abundance and total invertebrate density have been considered synonyms; to conform with the RAPPER (Schedule IV.I, Section 11) the term total invertebrate density, or simply density, will be used in this document.

[2] Although the RAPPER (Schedule IV.I, Section 11) only refers to the 'similarity index', the Bray-Curtis index, actually a dissimilarity index, is the selected indicator. This document will refer simply to the Bray-Curtis index.

Figure 1-1: The Pulp and Paper EEM Program Sequence[1].



[1] It is understood that at any time a mill may proceed to a more detailed level of study than recommended by Figure 1-1 should they desire (i.e., magnitude and geographical extent or investigation of cause).

Statistical significance implies that the mean of measurements between exposure and reference areas differ, but does not mean that the difference is important. The ability to detect effects depends on the size of the difference, and how many fish or benthic samples are examined. Where large differences exist between reference and exposure areas, few samples are required, while detection of smaller differences requires more samples.

Sample sizes recommended for the EEM program within this guidance document are sufficient to detect differences of 25% for the fish survey endpoints, with the exception of condition factor for which a 10% difference can be detected, and differences of 2 standard deviations (SD) for the benthic invertebrate endpoints.

The definition of effect allows further monitoring efforts to be tiered. Where no effect has been detected, and this result has been confirmed by two consecutive cycles, the mill may skip one monitoring cycle and conduct the next study in six years.

1.3.2 Has the effect been confirmed in two consecutive studies?

When an effect is observed, the mill will need to conduct a second study which will be designed to confirm the observed effect, and confirm that the effect is not a statistical anomaly. The effect is assumed not to be mill related until confirmation of the effect is completed in the second study.

It is recognized that attribution of the cause of the effect to the mill may be difficult in some circumstances. Environment Canada recommends that where the previous study has determined there are effects, and there is doubt that the effect is caused by the mill, the second study confirming the effect be designed in a way to maximize the confidence that the effect is mill related. Adjustments to the study design are described in the following chapters and could include increased sample efforts in both reference and exposure areas, changing sampling areas or, the use of mesocosms or caged bivalves.

1.3.3 Does the measured effect exceed critical effects sizes?

Results from Cycle 2 EEM studies have provided Environment Canada good information on the range of effects downstream of pulp and paper mills in Canada (Lowell *et al.* 2003). As a result of the data collected, Environment Canada has developed critical effect sizes for key fish and benthic invertebrate survey endpoints. These critical effect sizes are shown in Table 1-1. A mill will conduct magnitude and extent monitoring studies if the previous studies have shown an exceedance of the same critical effects sizes in two consecutive surveys. (i.e. a mill has measured an exceedance of the effect sizes in Table 1-1, for the same measurement endpoint, the difference from zero was the same direction, and the effect was confirmed in two consecutive studies).

Critical effect sizes in Table 1-1 ensure that increased monitoring efforts are focused in the appropriate areas. Critical effect sizes shown in Table 1-1 were derived after Cycle 2 results showed that the vast majority of mills in Canada reported significant statistical differences in at least one of the core measurement endpoint. Please note that Table 1-1 does not include an indicator of fish survival. Indicators of fish survival require accurate measurements of the age of fish. Such measurements can be unreliable and difficult to obtain particularly for some species of fish and as a result are not practical for guiding further monitoring efforts. Due to the uncertainty in these types of measurements, indicators of fish survival, which require knowledge of the age of fish, are considered to be very important in the overall assessment of the impacts of effluent, and will be reported, but will not trigger magnitude and extent monitoring in the absence of any exceedances of the critical effect sizes outlined in Table 1-1.

Details on how to calculate these endpoints and effect sizes is described in detail in Chapter 7. It should be noted that the Bray Curtis Index and Simpson's Evenness Index

were first reported in Cycle 3. Therefore, mills reporting effects only on these endpoints will need to confirm their results in Cycle 4 prior to advancing to magnitude and extent studies.

Table 1-1: Critical effect sizes for EEM for pulp and paper mills.

Endpoint	Recommended Effect Size (difference from reference)
Fish Populations	
Relative Gonad size	±25%
Relative Liver size	±25%
Condition	±10%
Benthic Communities	
Density	±2SD
Richness	±2SD
Simpson's Evenness	±2SD
Bray-Curtis Index	±2SD

Note: differences in fish population studies are expressed as percent (%) of reference mean, while differences in benthic community surveys are expressed as multiples of within-reference-area standard deviations (SDs).

Mills that have measured effects that do not exceed the values in Table 1-1 will continue to monitor every three years. This monitoring will be designed to verify whether or not the effects measured are becoming larger over time, and as a result will continue to answer the question: is there an effect?

1.3.4 Is the magnitude and geographical extent of the effect known?

When an effect exceeding values in Table 1-1 is confirmed, the mill will proceed to the next question of data assessment and interpretation and assess the magnitude and geographic extent of the effect. The intention of the EEM program is to have the mills with the most significant effects conduct this more detailed monitoring.

The purpose of magnitude and geographic extent monitoring is to determine the magnitude and geographic (spatial) extent of the effect that exceeds the effect sizes indicated in Table 1-1. The design of magnitude and geographic extent monitoring studies will be site-specific and will include sampling additional exposure areas progressively further from the effluent discharge, until the effect is no longer present. This may require more than one EEM study.

The scope may be broadened to include other environmental components, additional indicators or measurements to help define the magnitude of effect and clarify the understanding of effects. Magnitude and geographic extent monitoring studies may address the following questions:

- Are other components of the aquatic ecosystem likely to be affected suggesting that additional monitoring is needed?

- Is the effect of an acute or chronic nature?
- Is the effect related to chemical contamination or physical disruption, or both?
- Are fish and/or the benthic invertebrate community directly affected or are effects mediated through their food webs?

1.3.5 Is the mill related cause of the effect known?

When a mill related effect on fish, fish tissue or the benthic invertebrate community is observed, and its extent and magnitude are known but previous monitoring has failed to provide a satisfactory explanation of the cause of the effect, the mill will conduct an investigation of cause monitoring study. Guidance is provided within Chapter 12 on how to conduct such monitoring and the level of detail desired.

1.3.6 After Investigation of Cause Studies

Once a cause of the effect has been identified, the corrective actions may be considered. While this is outside EEM, Environment Canada will work with the mill and local stakeholders to help the mills meet their risk management goals. Environment Canada, in consultation with Fisheries and Oceans Canada, has developed a "Guidance for Determining Follow-up Actions when Effects Have Been Identified in Environmental Effects Monitoring (EEM)" which is available on the EEM website (http://www.ec.gc.ca/eem/english/ Publications/default.cfm). This document provides guidance to regulatory agencies, regulated facilities, and EEM practitioners for determining follow-up actions when effects have been identified in EEM. It discusses the factors that need to be considered for determining follow-up actions, and explains the roles and responsibilities of government, industry, and stakeholders in this process.

When the mill related cause is known, the mill continues monitoring the effect to ensure there are no new effects detected and to report on the potential change in effects already observed.

1.4 Elements of EEM Studies

As previously discussed, the EEM program is based on a succession of phases starting with the development of a study design based on reckognized scientific methods to study the potential effluent effects and how the study will be conducted. Once the study design is finalized, the field sampling is conducted as per the study design, and the data from the study are assessed and reported on. Further details on each of these program elements are provided below.

1.4.1 Study Design

The study design outlines how the biological monitoring will be conducted. Study designs will be submitted at least 6 months before each biological monitoring study is conducted. It will include:

- a site characterization;
- a description of how the fish population study will be conducted;
- a description of how the fish tissue study will be conducted;
- a description of how the benthic invertebrate study will be conducted;
- the dates and times when any samples will be collected;
- a description of the quality assurance and quality control measures that will be taken;
- a summary of the results of any previous biological monitoring studies.

The site characterization is information that is needed to prepare an EEM study design. For biological monitoring studies, information on site characterization will be submitted in summary format if a previous study design contained detailed site characterization information. Any changes to previous information submitted will be detailed each time a study design is submitted. There is a variety of information needed: mill operation, production process and treatment system; manner in which the effluent mixes in the receiving environment (see plume delineation, Chapter 2); description of sampling areas; and, description of confounding factors.

When a mill submits a study design to assess the extent and magnitude of effect, the description of one or more additional sampling areas within the exposed area will be included. If a mill is conducting an investigation of cause monitoring study, the study design will consist of a summary of previous biological monitoring studies and a detailed description of field and laboratory studies that will be used to determine the cause of effect.

The concepts and basic elements of quality assurance/ quality control (QA/QC) are discussed in this Guidance Document for each component. QA/QC procedures should be set *a priori* as part of the study design, and those that will be implemented should be described, in order to ensure validity of the data. Quality assurance results that may affect the reliability of the conclusions will be submitted as part of each interpretative report.

There are other recommendations pertaining to study designs that are described in Chapter 2 (e.g. design of the monitoring approach, confounding factors, etc).

1.4.2 Field Studies

Biological monitoring studies are conducted according to the study design that was submitted. It is understood that circumstances may arise that make it impossible to follow the study design. The mill will inform the authorization officer as soon as possible of how the study was or will be conducted, and these changes will be documented in the interpretative report.

1.4.3 Data Assessment

After completing the field work, data assessment and interpretation will be conducted to determine if mill effluent is causing an effect and what the future monitoring requirements will be. Chapter 7 describes the specific data assessments that are done in order to determine if there are effects on fish, fish tissue or the benthic invertebrate community.

1.4.4 Interpretative Reports

Interpretative reports will be submitted to the authorization officer. The interpretative report will include a large array of information: description of any deviations from the study design; location and description of the sampling areas; dates and times of sampling; sample sizes, calculations of all effect endpoints, and results of supporting water quality monitoring data. Chapter 9 describes what will be included in the report.

The conclusions of the biological monitoring studies will be reported, based on the statistical results on the fish and benthic invertebrate survey taking into account any other factors that may have affected those results (results of previous biological monitoring studies, presence of anthropogenic, natural or other factors that are not related to the effluent, quality assurance or quality control results which may interfere with reliability of the conclusions, exposure to effluent of the fish that were sampled).

The interpretive report will describe the impact of the results on the study design for subsequent biological monitoring studies and specify the date of the next biological monitoring studies.

An interpretative report submitted when the mill is conducting an Investigation of cause study may not contain all of the same information as other biological monitoring studies. If investigation of cause was conducted, the report will include a description of any deviation from the study design that was submitted, the dates and times when the samples were collected, a description of how the conclusions will impact subsequent study designs, and the date when the next monitoring will occur. The interpretative report will include information pertaining to the cause of the effect that is being studied. If the cause was not determined, the report will include an explanation of why and what will be done in the next monitoring cycle to identify the cause.

1.5 Monitoring Components

As discussed previously, EEM studies are comprised of biological monitoring, effluent quality monitoring, and the measurement of supporting environmental variables. Each component is briefly described below, as well as indicating where further information is provided within this document.

1.5.1 Biological Monitoring: The Fish Survey

The fish survey (Chapter 3) will consist of a study of the ***fish population*** (using indicators of fish population health) to determine if mill effluent is having an effect on the fish.

Note that a mill does not have to conduct a fish survey if the concentration of the effluent in the exposure area is less than 1% within 250m of a point of deposit of the effluent in water. The description of how the effluent mixes with the receiving water is included in the study design as part of the site characterization.

The fish survey is conducted to determine if there have been changes in indicators of fish growth, reproduction, condition and survival. The scientifically defensible method recommended to determine if there are changes in these indicators is by collecting fish species found in the exposure and reference areas, or along an effluent concentration gradient, measuring length, weight, age, liver or hepatopancreas weight, and if fish are sexually mature, gonad weight, fecundity, and egg weight. Depending on the site specific context, not all of these measurements may be possible in all fish. Results for fish collected in the exposure area will be compared statistically with those from fish collected in the reference area. From the above measurements, the following indicators will be used to determine potential effluent effects on fish:

- age (survival);
- size-at-age (body weight against age) (energy use - growth);
- relative gonad size (gonad weight against body weight) (energy use - reproduction);
- condition (body weight against length) (energy storage - condition); and
- relative liver size (liver weight against body weight) (energy storage - condition).

1.5.2 Biological Monitoring: The Benthic Invertebrate Community Survey

Mills will conduct a benthic invertebrate community survey (Chapter 4) to determine if their effluent is having an effect on fish habitat. This is done by collecting benthic invertebrates in the exposure area and reference area or a gradient of exposure areas and comparing measurements of benthic invertebrate. The following indicators will be used to determine potential effluent effects on the benthic invertebrate community:

- density;
- taxa richness;
- Simpson's evenness; and
- the Bray-Curtis index.

To ensure site-specific flexibility, mills can choose from any of several scientifically defensible sampling designs, including control/impact, gradient, and the reference condition approach. Sample sizes (i.e., number of sampling stations) are determined site-specifically using statistical power analysis. Samples from both the exposure and

reference areas will be collected in the most "ecologically relevant" area (i.e. considering habitat type with the highest benthic invertebrate diversity and the dominant habitat in the exposure area) and season (i.e. the time of year when the benthic invertebrate diversity is highest and benthic invertebrates are most exposed to effluent).

1.5.3 Biological Monitoring: Fish Usability

A fish tissue analysis is conducted if, since the submission of the most recent interpretive report, the mill effluent contained a measurable concentration of 2,3,7,8-TCDD or of 2,3,7,8-TCDF, or if an effect on fish tissue was reported in the most recent interpretative report. The tissue samples should be collected from fish species that are locally consumed.

An assessment of the impact of the effluent on fish usability will be conducted if any complaint within the three preceding years to the owner or operator of a mill about fish flavour or odour (i.e. fish tainting) has been made.

1.5.4 Alternative Monitoring Methods

At some mill sites the biological monitoring methods described above (particularly the fish survey and benthic invertebrate community survey) may not be appropriate. The most common reasons for this are the presence of hazardous conditions (e.g. high water velocity) or the presence of confounding factors such as other effluent discharges in the exposure area, that will make it difficult to isolate any effects attributable to the effluent being monitored.

Where mills cannot design the fish or benthic invertebrate community surveys in a manner such as to resolve difficulties, mills will provide a scientific rationale and justification and propose cost effective and technically feasible alternative monitoring methods within the study design.

A number of alternative monitoring methods are recommended in this Guidance Document (Chapter 11). Mills may choose these, or other scientifically defensible monitoring methods that meet the guidelines for alternative methods. The key to any alternative monitoring method is that the method have the proven ability to determine, in a scientifically defensible manner, if the effluent is having effects on the fish population (growth, reproduction, condition and survival), fish tissue (levels of dioxins and furans) or the benthic invertebrate community (benthic invertebrate density, taxa richness, the Simpson's evenness and the Bray-Curtis index. Currently recommended alternative monitoring methods to the fish survey are mesocosm studies and caged bivalves. For benthic invertebrate community surveys, the currently recommended alternative monitoring method is a mesocosm study.

1.5.5 Sublethal Toxicity Testing

Sublethal toxicity data generated through the testing of an effluent from a specific discharge location over time can provide an indication of the degree of variability in effluent quality and temporal trends. Mills will conduct sublethal toxicity testing on a fish, invertebrate and algae species. Endpoints measured in the sublethal toxicity tests include survival, growth and reproduction. Sublethal toxicity testing will be conducted on effluent samples collected from the mill's outfall structure that has potentially the most adverse effect on the receiving environment. More information on how to determine this is found in Chapter 2.

Mills will conduct sublethal toxicity tests twice in each calendar year. A sublethal toxicity report will be submitted to the authorization officer within three months after the tests are completed. If the mill deposits effluent fewer than 120 days in any calendar year they will conduct the testing and submit the results of sublethal toxicity tests only once in respect of that calendar year. For more information on sublethal toxicity test methodology, their uses, and reporting, refer to Chapter 6. For information on submission of sublethal toxicity data see Chapter 8.

1.5.6 Environmental Supporting Variables

When a fish population or benthic invertebrate community study is conducted, water samples will be collected from the sampling areas and the following information is to be recorded:

- water temperature;
- depth;
- concentration of dissolved oxygen;
- if effluent is deposited into fresh water, hardness, total phosphorus, total nitrogen, and total organic carbon, pH, electrical conductivity; and
- if effluent is deposited into marine or estuarine waters, salinity.

Also, when a mill conducts a benthic invertebrate survey, sediment samples will be collected from the sampling areas (except when sampling is conducted in erosional habitats). The particle size distribution and total organic carbon will be recorded and if the effluent is deposited into marine or estuarine waters, ratio of carbon to nitrogen, redox potential (Eh), and total sulphides are also recorded. More guidance on environmental supporting variables can be found in Chapter 5.

1.6 Implementation of Environmental Effects Monitoring

Each owner or operator of a mill regulated under the EEM requirements is responsible for ensuring that EEM is completed in accordance with the RAPPER.

The Authorization Officer (AO) is as prescribed in the PPER (Schedule V). The AO will provide feedback to the facility on submitted study designs and interpretive reports. This feedback is generally developed by a designate to the AO, in consultation with other federal government experts, as well as experts in provincial and territorial governments.

The National EEM Office within Environment Canada co-ordinates the assessment of the results of the EEM program on a national basis and the management of the data archive for the EEM program.

The EEM Science Committee is comprised of scientific experts in all aspects of the EEM program. The Committee serves to ensure the EEM program continues to evolve with our scientific understanding, and offers technical expertise to the designates of the AOs reviewing EEM study designs and interpretive reports.