Environmental and Social Risks of Pig Farming in Chapais

October 2005

Environmental and Social Risks of Pig Farming in Chapais

Synthesis Report to

Oujé-Bougoumou Eenuch Association
Waswanipi First Nation
Cree Board of Health and Social Services

Prepared by :

Alain N. Rousseau Ph.D., ing.
Simon Ricard ing. Jr., M.Sc.
Renaud Quilbé, D.Sc.

Centre Eau, Terre et Environnement
Institut National de la Recherche Scientifique (INRS-ETE)
490 de la Couronne, Quebec (Quebec), G1K 9A9

Report N° R-806-s1

October 2005

ISBN : 978-2-89146-830-5

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INTRODUCTION

Since the closing of the Opemisca Mine in 1998, the Chapais Region has experienced economic problems. With a high unemployment rate (up to 17% at Chapais) and a strong exodus of the labour force, the undiversified local economy mostly depends on forest exploitation (timber). Created in 2000 and led by Mr. Jacques Bérubé, Mayor of Chapais, the CDEC is an organization aimed at promoting development of the regional economy. Focusing on potential economic benefits, the CDEC is proposing the project "Quebec Northern Agri-Food Project in the Production and Transformation of Natural Pork Meat", an initiative of the *Groupe Les Aliments Naturels Chapaisiens Inc.* (a.k.a., Goupe A.N.C. Group). *ROBERT HAMELIN & associés* was contracted by *Consultant LEGOFF Groupe inc.* to conduct a study on the potential impact of the pig farming project in Chapais.

The scope of this summarized document[1] is to present a complementary analysis of potential environmental and social risks of the proposed pig farming project initiated by CDEC. Based on the current state of knowledge with regard to the northern boreal environment and pig farming in Central Quebec, this document highlights that the targeted environment will be sensitive to potential disturbances related to intensive pig farming.

[1] Full text version : Rousseau, A.N., S. Ricard, R. Quilbé, 2005. *Current State of Understanding of Potential Environmental and Social Risks of Pig Farming in the James Bay Municipality, near Chapais*. Rapport de recherche No R-806. Centre Eau, Terre et Environnement, Institut national de la recherche scientifique, INRS-ETE. Québec, PQ.

1 BACKGROUND INFORMATION

1.1 PIG FARMING IN QUEBEC

Over the last three decades, pig production in Quebec underwent a tremendous expansion. Pig farming now represents the second largest agricultural activity in Quebec, right behind dairy farming. This sudden growth, combined with the pressure of demand-driven open market, resulted in Quebec's pig producers to focus their production methods on productivity, industrialization and specialisation. This resulted in the intensification of pig production. The agricultural production areas are mainly located in central Quebec. Three quarters of pig farms are located in *Montérégie, Chaudière-Appalache* and *Centre du Quebec*. The *Abitibi-Témiscamingue* region is the second smallest pig producing region.

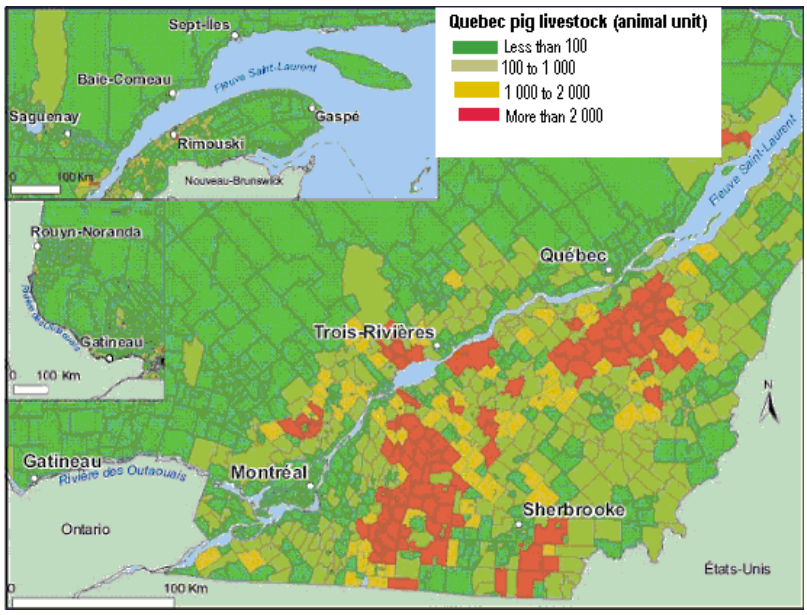

Figure 1 **Distribution of pig livestock population in Quebec** ([BAPE, 2003], volume I, p. 67, adapted from PROD93)

1.2 THE QUEBEC PIG FARMING MODELS

According to the Environmental Public Hearings Office on pig farming development in Quebec[2], pig production can be described with regards to three main characteristics:

(1) **ownership**, that is, the producer either owns infrastructures and animals or acts as a manager on behalf of an integrator;

(2) **relationship with the land**, that is, a producer either owns cropland to spread slurry as fertilizer, or not;

(3) **specialization status**, that is, the producer is either involved in all production phases, or in a few phases.

1.3 LEGAL REQUIREMENTS

A pig farm promoter must respect directives set by the Provincial Administrator, the James Bay Northern Quebec Agreement (JBNQA) and the conditions established in the Regulation Respecting Agricultural Operations (REA). Furthermore, new Municipal Bylaws, as stated in Bill 54, namely municipalities, are required or have the right to:

(1) **impose additional requirements** with respect to zoning of livestock operations, minimal separating distances, and protection of woodlots, riparian zones, and sensitive areas;

(2) **regulate and set quotas** for pig production in their territory; and

(3) **hold a public consultation** before expansion or establishment of certain pig production facilities; in order to provide information to citizens, answer questions, hear concerns and elaborate mitigation measures.

However, the Quebec Ministry of Municipal Affairs and Regions (MAMR) insists on clarifying the goal of the consultation process:

> **"[…] the public consultation is not an opportunity to judge the relevancy of authorizing or not the project, neither to weigh up the impacts on environment since all unacceptable projects, with regards to municipal or Quebec Ministry of Sustainable Development, Environment and Parks (QMDDEP) rules, will have already been rejected.[3]"**

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[2] (BAPE) Bureau d'audiences publiques sur l'environnement. 2003. *Consultation publique sur le développement durable de la production porcine au Québec.* Rapport d'enquête et d'audience publique. N° 179, .Rapport principal – L'inscription de la production porcine dans le développement durable, 251 p.

[3] (MAMR) Quebec Ministry of Municipal Affairs and Regions,2004. Modifications visant la production porcine et mesures connexes. *Muni-express*, N°8-12 novembre 2004, p.3.

2 THE ENVIRONMENT

2.1 THE BOREAL FOREST

The area surrounding Chapais can be considered significantly sensitive to environmental disturbance. The open and closed boreal forest is interlaced with large rivers, lakes and wetlands, and provides habitats for a large number of mammals and birds. Streams are rare and drainage capacity is low, slopes being nonexistent or weak on most of the territory. Located on bedrock covered by thin glacial deposits, surface water quality is generally good due to low human pressure. Watersheds are very large and lakes are numerous, most being small and shallow. Wetlands cover about 10% of the landscape. The hard rock formation of the Boreal Shield makes the soil less sensitive to erosion than in sedimentary landscapes. Water clarity and eutrophication are mainly controlled by drainage ratio (watershed area divided by lake volume) and watershed slope, which implies that lakes of large and flat watersheds may be more susceptible to enrichment from watershed disturbances[4].

Forest exploitation can have an impact on river morphology, streamflow, water quality and aquatic ecosystems. The nature and extent of these impacts depends on climate, geology, topography as well as forest structure and composition. Boreal forests are fragile ecosystems with a slow dynamic and any disturbance, such as wildfire and logging, can have strong adverse effects on these ecosystems, requiring a long recovery period. However, there is very little data about these effects. Most studies on the impact of wildfire and logging in the Canadian boreal forest are concerned with ecosystems, wildlife and soils. Very little information related to water quality has been collected at the watershed scale.

2.2 LAND USES

Significantly remote from major markets, agricultural production is marginal as the boreal environment is established either on glacial till, or characterized by shallow-soils and infertile

[4] Carignan, R., D'Arcy, P., and Lamontagne, S. 2000. Comparative impacts of fire and forest harvesting on water quality in boreal shield lakes. *Can. J. Fish. Aquat. Sci.* 57(Suppl. 2): 105-117.

uplands alternating with poorly drained organic soils with significant nitrogen limitations to plant productivity[5]. The coniferous tree species of the boreal forest have excellent properties for pulping, dimensional lumber and plywood or other panelling. The softwood cover is densely populated, with strands and forests of black and red spruces and grey pines. Other commercial uses of the boreal forest have been mostly centered around mining activity and hydroelectricity production.

2.3 WATER USES

In northern Quebec, surface waters are mostly used for transportation, fishing, drinking, hydroelectric production, mining, industry, forest exploitation and recreational activities. Overall human pressure on the numerous lakes and large watersheds is low but water management problems exist and they are related to obsolete or total lack of sanitation infrastructures in some municipalities and to environmental impacts caused by the logging and mining industries. Industrial activity uses huge quantities of water and has important impacts on water quality such as acidification due to accumulation areas of mining residues, heavy metals contamination and wind erosion. Only half of the inactive accumulation areas have been restored because of high treatment costs. Logging has also a direct impact on surface water quality. The region has several lumber transformation factories that use and pollute water. Lixiviation waters coming from a non-active and non-restored wood residue plant contain a lot of organic chemicals that can contaminate surface and ground waters (phenols and resin acids). Over 80% of the residents are supplied by surface waters with, for the majority, chlorination treatment. In Chapais, water supply infrastructures are old and deficient. A monitoring program detected concentrations of trihalomethane above the drinking water standard. Moreover, the municipality does not treat wastewaters; they are discharged directly into a ditch that drains into the Obatogamau, Chibougamau and Waswanipi rivers

5 Burton, P.J., *et al.* 2003. The current state of boreal forestry and the drive for change. Chapter 1. In Towards Sustainable Management of the Boreal Forest. Edited by P.J. Burton, C. Messier, D.W. Smith, and W.L. Adamowicz. NRC Research Press, Ottawa, Ontario, Canada. pp. 1-40.

3 THE PIG FARMING PROJECT

3.1 CONSTRUCTION

Most of buildings of the pig farming complex will be constructed on the Trapping Territory of Mr. Malcom Dixon of Waswanipi Cree Community. The area is mostly forested and corresponds to Public Lands Category III. Breeding sites will be located on a strip of land, roughly located along the Obatogamau River, 11 to 20 km South-West of Chapais. A grain storage facility, a feed mill, an administration office, and a garage will be constructed on the South-West outskirt of Chapais while a slaughterhouse will be located in the city's industrial park. Representing a 75-M$ investment, the pig farming project will support local economy by creating 135 direct jobs. The construction of 43 buildings is planned over a four-year period and will require the clearing of 32 hectares of land (cutting trees, burning branches, extracting stumps and grading). Water will be supplied by artesian wells at each site or in surrounding eskers. The construction of reservoirs will provide a 24-hour water supply. An enlargement of the current gravel road is required over a 5.2-km stretch. An equivalent distance is needed for the construction of access roads leading to all buildings. To ensure protection against fire spreading in the surrounding areas, the promoters will implement the following security measures:

(i) annual **fire fighting training** of some workers;

(ii) construction of two 750-m^3 **water dugouts** close to the birth and finishing sites;

(iii) ensure the **permanent presence of fire trucks** (bought by the promoters) close to finishing sites and the main access road; and

(iv) implementation of a 30-m **fire barrier** and a 20-m **buffer zone**.

3.2 OPERATIONS

Grains required to prepare animal rations will be transported from surrounding crop production sites (*e.g.* Saguenay, Lac Saint-Jean, Abitibi, Southern Quebec) to the feed mill by train or truck. Total annual feed supplied is estimated at 43,503 tons per year, which represents

a daily supply of eleven 15-ton trucks. Once completed, the agricultural complex will have a capacity of 70,010 animals (equivalent to 6,563 animal units[6]), the largest pig farm in Quebec.

Table 1 : Pig farming infrastructures

Building Function	Number	Distance from Chapais (km)
Quarantine	1	24.0
Artificial insemination center	1	25.3
Selection-multiplication		
Birth	1	24.9
Nursery-finishing	1	24.9
Slurry treatment plant	6	17.0-23.5
Building A		
Building B		
Building C (bioreactor)		
Office and garage	1	4.8
Other garage	1	20.0
Grain storage facility and feed mill	1	4.7
Birth		
Gestation	3	22.2-23.5
Maternity	3	22.2-23.5
Nursery	8	20.3
Finishing	15	17.0-19.8
Slaughterhouse	1	0.0
Slaughterhouse wastewater treatment plant	1	0.0
Building A		
Building B		
Building C		
Incinerator	1	18.7
Total	43	

Source: [Consultants LEGOFF Groupe inc., 2005], p. 31.

[6] Animal unit: A measure of livestock numbers by which kinds, classes, sizes, and ages are converted to an approximate common standard in relation to feed and forage consumption of a mature cow (i.e., 1,000 lb live weight).

Table 2 : Livestock of the Chapais pig farming project

Sites	Livestock	Total number of animals	Animal Units
Quarantine	Gilts	460	71.9
Artificial insemination center	Boars	60	9.1
Multi-birth	Sows	740	145.1
Multi-nursery	Weaned piglets	2,450	62.8
Multi-finishing	Finishing gilts	2,900	483.4
Birth (3 buildings)	Sows	5,520	1,082.4
Nursery (8 buildings)	Weaned piglets	20,480	525.1
Finishing (15 buildings)	Finishing pigs	37,500	4,213.5
Total		**70,010**	**6,563**

Source: [Consultants LEGOFF Groupe inc., 2005], p.47.

3.3 WASTE MANAGEMENT

Produced slurry will be biologically treated by six plants. Feces will be filtered and dehydrated to produce a valuable and reusable a material for agriculture called *biosolids*. A rapid biological process reduces the period where slurry is stocked, reducing the amount of odour produced.

The three options being considered for valuing the 50 m³ of *biosolids* produced daily are as a:

(i) combustible for the cogeneration plant of Chapais;

(ii) fertilizer for surrounding and remote cropland; or

(iii) fertilizer for the surrounding logged areas.

The feasibility of these options has not yet been demonstrated.

The slurry treatment will also produce daily up to 350 m³/day of effluent, the liquid fraction of the slurry. The effluent will be biologically and electrochemically treated then discharged into Obatogamau River. Effluent discharge requires an authorization of the QMDDEP.

On an annual basis, 135,200 pigs will be slaughtered representing 3,380 tons of organic matter. Most of animal carcasses, placentas, fat and blood will be directly shipped to an incinerator located 18.7 kilometres from Chapais. Fourteen incinerators will operate up to 12 hours a day, five days a week. The amount of ashes produced will be stockpiled in a storage facility before being shipped to a dump site 20 km from Chapais.

4 THE IMPACTS

Inappropriate agricultural practices have been associated with undesirable impacts on water, air and soil quality, as well as health risks for workers and surrounding populations. In southern quebec, the impact of intensive agriculture on the contamination of wells and municipal water supplies has been scientifically demonstrated[7], resulting from a lethargic application of legislation over three decades. No similar pig farming project, with respect to its size, has ever been developed in northern quebec, constraining comparison and evaluation of the scope of impacts. However the current state of knowledge provides key information to anticipate potential impacts of pig farming on a boreal environment.

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4.1 …ON WATERS

Nitrogen (N), **phosphorus** (P), **cyanobacteria** and **fecal coliforms** are parameters used to evaluate pollution of either ground or surface waters. These pollutants come mostly from agricultural sources and can have undesirable impacts on water quality and human health. Soils have a natural capacity to filter pollutants contained in water, but when their concentrations exceed their filtering capacity, pollutants can percolate to ground waters, migrate and contaminate defective wells. Runoff caused by rainfalls and floods can also transport pollutants to surrounding streams. High concentrations of these elements limit water uses like drinking water and recreational activity. Furthermore, the **chlorine** used in water treatment processes reacts with organic matter to form **carcinogenic** and **toxic by-products**.

A study[7] focusing on seven watersheds in Central Quebec, demonstrated that in intensively cultivated areas, more wells were contaminated by **nitrates**. Municipal water supplies collecting groundwater presented higher **ammonia-nitrogen** concentrations while those collecting surface waters presented larger **phosphorus** and **nitrate** concentrations.

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[7] Rousseau, N., et al., 2004. Étude sur la qualité de l'eau potable dans sept bassins versants en surplus de fumier et impacts potentiels sur la santé. QMDDEP, 19 pp.

Deforestation systematically disturbs the hydrological regime by increasing annual runoff. The **drainage ratio** (watershed area divided by lake volume) is a key indicator of the sensitivity of surface water to watershed disturbance, a high drainage ratio (that being the case in northern boreal environment indicating high sensitivity of forest disturbance on water quality. The main consequence of deforestation is an increase of low water peak flows producing an impact on river morphology, notably by modifying erosion processes. Many studies in American and Canadian (in north-western Ontario and northern Quebec) forests have shown that **deforestation can cause**:

- Increase in **water temperature, turbidity** and **acidity**;
- Increase in **sediment concentration** due to water erosion of bare soil, river banks and river bed;
- Increase in **dissolved organic carbon** (DOC), coming from forest organic soils and carried by runoff and erosion;
- Increase in **biological oxygen demand** (BOD) inked with a decrease in **dissolved oxygen**;
- Increase mineral ions such as, **sulphur** (S^{4+}), **potassium** (K^{+}), **sodium** (Na^{+}), **iron** (Fe^{2+}), **chlorine** (Cl^{-}) and **mercury** (Hg^{+}), which become more mobile due to the absence of vegetation;
- Reduction in **grazer** (calanoid copepods), **small yellow perch** and **white sucker** populations;
- Strong increase in **mercury concentrations**, contaminating the aquatic biota via bioaccumulation and biomagnifications through the food chain.

4.2 … ON FORESTS

The implementation of a large-scale, pig farm project in the boreal environment will most likely result in some direct deforestation on 32 ha. Additional cropland may be necessary for the disposal of pig slurry as an organic fertilizer. This would lead to further deforestation in order to develop agriculture where soil conditions may or may not be favourable, enhancing undesirable effects on water as aforementioned.

4.3 …ON SOILS

Soils provide nutrients to crops, act as water and biomass reservoirs and as water filters. When used properly, *biosolids* support crop production and improve physical properties of soils including the capacity to retain soil elements and moisture. Soil quality can be affected by bad cropping practices, causing soil compaction and erosion. Improper fertilization can result in excessive nutrients in the environment that can cause an increase in soil P and pathogenic microorganism content. In the surroundings of Chapais, the poor soil quality (dominated by tills) combined with a low drainage capacity, would indicate greater logged areas for a given amount of slurry to be spread.

4.4 … ON AIR

"According to several studies, if soil management is deficient, environment and health risks exist " [BAPE, 2003].

The promoters agree that emanation of odours produced by the pig farm represents a major concern for the local population. Four main odour sources have been identified: the slurry treatment, the incineration of slaughterhouse wastes, the production of rations at the feed mill, and the potential combustion of *biosolids* at the cogeneration plant. Atmospheric emissions can take the form of gases that may contain microorganisms and small suspended particles. The principal gases produced include **ammonia** (NH_3), **methane** (CH_4), **nitrous oxide** (N_2O), **carbon dioxide** (CO_2) and **hydrogen sulfide** (H_2S). These products are known to cause **smog** and **cancer** among exposed population and may also contribute - in the long run - to the **disintegration of the ozone layer** and to **climatic changes**. Dusts confined in pig housings can cause to workers different **allergic reactions** and are responsible for **breathing problems**.

4.5 … ON WILDLIFE HABITATS

In the last decade, increasing deforestation in agricultural regions has raised concerns over endangerment to animals and plant species. The residual forested surface is a victim of fragmentation due to the isolation of small, forested zones and would have an impact on shelters, animal populations and biodiversity [BAPE, 2003]. The impact on wildlife habitats in boreal environment is hard to determine because inventories are unavailable. For animals having a large vital territory (such as wild cats, wolverines and peregrine falcons), a relatively

small reduction of their habitats should not compromise their ability to survive. For smaller animals (such as shrews and bats) with smaller vital territory, the impact could be critical.

Any modifications related to clear cutting, such as soil erosion and transport to streams of soil particles have disturbing effects local biodiversity of the benthic wildlife (organisms living in river sediments) that is already poor. The use of pesticides and fertilizers on agricultural land contributes to water degradation. In nutrient-enriched water bodies, the use of oxygen by plant respiration and by decomposition of vegetal biomass causes fish mortality. Presence of pig slurry in streams can cause important fish kill and can also be harmful to fish nourishment or aquatic animal reproduction, as well as increase vulnerability to bacterial diseases. Some herbicides and hormones present in poultry and pig slurry can have a direct impact on wildlife population, affecting development, reproduction and growth. Drainage increases runoff rate into streams and can cause the loss of shelter, spawning grounds and hatching zones. Losses of wetland can also be attributed to agricultural development, particularly to drainage of riparian zones[1].

4.6 …ON HEALTH

Agriculture constitutes one of the most high-risk sectors of the economy for workers. The rate of fatal agricultural accidents is significantly high. Health problems associated with pig farms stem from two causes; either manipulation of agricultural equipment or presence of contaminants in the immediate farm environment. Contaminants can be of biological, physical and chemical natures and their effects on health are multiple. Resulting health risks come from direct contact with animals, air in farm buildings, toxins, and stress. Farm animals are frequently hosts of pathogenic microorganisms that may be transmitted to humans and cause adverse health effects. Contaminants generated by agricultural activities can have serious effects on the surrounding population. In fact, populations are at risk with respect to the presence of contaminants in both water and air. The effects of which may vary from diarrhea, nausea and dizziness to liver problems.

4.7 …ON SOCIETY

The economic spin-off due to the establishment of the pig farming project is a significant positive impact for local population. However, announcement of a new pig farm project has the potential to create a source of conflicts between producers and surrounding population. In

several Quebec municipalities, these conflicts have created social situations that affect the quality of life of all [BAPE, 2003]. People equate incoming agricultural projects with a reduction in their quality of life. The ensuing issues include: environmental effects (odours, noises, dust), environmental and health risks, local and regional economic consequences, impacts on other activities, and lack of local input on the project development. Often, conflicts emerge even if the projected infrastructures conform to regulations. Considering their specific vicinity with land on which they still rely for subsistence, aboriginal communities are potentially more vulnerable to negative impacts of pig farming activities.

5 MITIGATION MEASURES

The promoters suggested attenuation measures to limit as much as possible impacts related to pig farming activities.

5.1 … FOR WATER

(1) The slurry treatment plants will, in case of breakdowns, have a 35-day retention capacity;

(2) Part of the treated effluent will be reused for washing the gutters. A dilution analysis of the 350 m³ of effluent discharged into the Obatogamau River indicates that the resulting pollutant concentrations will meet the QMDDEP criteria;

(3) Groundwater quality will be monitored using piezometers located around the treatment plants and the other buildings; and

(4) Distant stockpiling of ligneous wastes and stabilization work on soils vulnerable to erosion will reduce the risk of increasing suspended caused by land stripping and grading activities.

5.2 … FOR AIR

(1) Most gas emissions produced by the pig slurry treatment plants will be reduced by **implementing the Biofertile® solution**. The process rapidity reduces slurry stockpiling duration thus brings down gas emission by up to 75%;

(2) **Appropriate separating distances** will ensure a decent level of odour nuisance for surrounding populations. An odour dispersion analysis was conducted to anticipate the areas affected by noxious odours. According to these results, the surrounding environment of Cavan Lake will be affected up to 15 hours per year while noxious odours will not reach the town of Chapais; and

(3) A **monitoring and control program** will be implemented to analyze odour spreading.

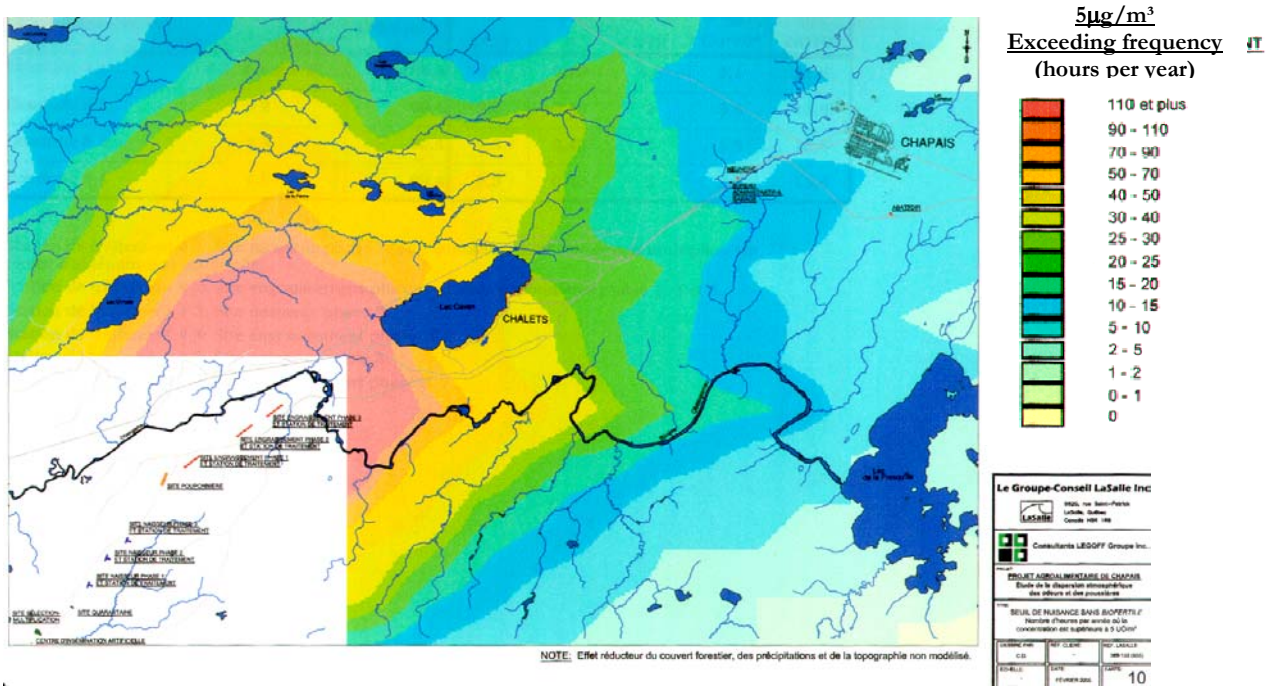

Figure 2 **Projection of the potential areas of odour nuisance** ([Consultants LEGOFF Groupe inc., 2005], p.166)

To reduce Small suspended particles caused by operations, the promoters are committed to:

(1) respect provincial **policies on granular material transportation**;

(2) respect **speed limits** on access roads;

(3) obtain a **burning authorization** from the QMRNFP; and

(4) respect the evaluated particles discharge of the incinerator (70µg/m³) is in accordance with **Regulation Respecting the Quality of the Atmosphere** (*Règlement sur la qualité de l'atmosphère* - RQA).

5.3 …FOR SOIL

(1) **constraining circulation of vehicles**;

(2) **restricting fuel supply** to a security zone; and

(3) **providing intervention equipment** in case of fuel spillage.

(4) **restoring the sites** after operation of the pig farm.

5.4 …FOR VEGETATION AND WILDLIFE

(1) to conduct an **inventory** of sturgeon spawning zones and small mammal habitats to investigate the presence of rare or threatened species;

(2) to evaluate the **survival potential** of each species; and

(3) to redefine, if necessary, **building locations**.

Adapted culverts and drainage ditches will reduce this impact on benthic wildlife:

(1) planning construction activities after spring flood;

(2) avoiding multiple construction projects on one river simultaneously; and

(3) locating culverts on straight sections of the river (avoiding meanders).

5.5 RESTORATION

After cleaning and demolishing the buildings, part of **residual materials will be recycled** or **transported at a local dumpsite**. Potentially **contaminated soils will be removed** and restoration works will be implemented over areas where the buildings will have been constructed. The promoters are committed to invest in a **restoration fund**, ten years after the beginning of the farm operations equivalent to 10% of the estimated restoration costs.

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6 POINTS TO BE CLARIFIED

For many reasons, some points are neither completed nor sufficiently explained in the impact study produced by the promoter.

6.1 WASTE MANAGEMENT PLAN

According to REA, the pig farming project must be supported by a **nutrient management plan** signed by a member of the OAQ (Quebec Order of Agronomists). At present, the promoter proposed three options to value *biosolids* (see Section 3.2), however, none of them has yet been thoroughly analyzed:

(1) The technical and environmental feasibility of the cogeneration option needs to be done. Moreover, *biosolids* produced by the Biofertile® technology present a weak market value for energy purposes. Moreover, resulting gas emission from the cogeneration plant has not been considered in the odour spreading analysis;

(2) Surrounding croplands do not provide enough area to value the amount of produced *biosolids*. Considering the high transportation costs, converting surrounding lands into cropland to value the *biosolids* becomes significantly conceivable. Related impacts on water (see Sections 4.0) are not considered in the impact study provided by the promoters; and

(3) Finally, using *biosolids* to fertilize logged area needs to be supported by analyses and scientific expertise that were not provided by the promoters.

The dilution analysis of the discharge of the effluent of the pig slurry treatment: does not mention the intended use of the targeted water. Legal discharge standards are stricter for water consumption and recreational activities. Moreover, slaughterhouse wastewaters will be discharged directly into Chapais municipal sewer system that does not have sanitation infrastructures, no impact analysis has been conducted concerning this.

6.2 MONITORING MEASURES

The promoters will hire and train an environmental technician to monitor ground water quality and the agro-environmental management plan. Observation wells will be dug around treatment

plants and breeding centers to collect water samples on a seasonal basis. Moreover, the technician will ensure appropriate operations (management of slurry, transportation of biosolids and animal carcasses, incinerator operation) to reduce the amount of noxious gases produced. An operation register will be updated and available. Even though a technician will be responsible for monitoring measures, there should be provisions for an external and neutral investigation procedure.

6.3 SCIENTIFIC LIMITS

The impact study is currently evaluated by a comity of experts of the QMDDEP (*COMEX*) to judge the conformity with regards to current environmental legislation on pig farming. One must understand that the scientific approach, while dealing with environmental issues, is constrained by methodological limits:

(1) A high level of subjectivity cannot be completely avoided. Environmental impact evaluations must be based on data as well as the current state of scientific knowledge;

(2) Results being supported by detailed (and sometime complex) justifications, impact studies are hard to understand for non-scientists, leaving out most citizens from the decision process;

(3) Impact studies consider projects as isolated systems. That means that there is no way to cope with cumulative impacts on a larger scale. Causes of diffused pollution are hard to evaluate precisely, but their existence is undeniable;

(4) There is no way to predict with certainty if a practice or plan is sustainable in the long run because of unpredictable fluctuations in ecological and socioeconomic systems, as well as limitations to present knowledge; and

(5) The fact that scientific analysis is in accordance with governmental standards does not ensure definitively environmental sustainability.

7 ECOLOGICAL RISKS

Risk is a subjective concept that can be defined, with regards to environmental issues, as a probability that undesirable or unfavourable effect might occur from a given exposure to a pollutant. While evaluating environmental risks, an accurate adequacy must be conducted between the expected value and probability of occurrence of both benefits and undesirable impacts. A "zero-risk" assessment is impossible. The notion of risk management is overly neglected by conventional impact study.

Figure 3 Risk evaluation

Social perception of risk basically depends on uncertainty as well as distribution of benefits and undesirable impacts. There are significant limitations while defining probability of occurrence because gathering accurate information and conducting relevant studies are highly expensive. Interpreting impact studies is thus characterized by a certain level of uncertainty. Environmental risk management also implies a partition of damages and benefits among many social actors (promoters, citizens, scientists, governmental representatives). The decision process through which the risk is managed is highly politicized. If risk partition is perceived as unfair social tensions between actors and stakeholders will most likely arise.

8 CONCLUSION

The information gathered in this document demonstrates that the pig farming project potentially poses a significant environmental risk. This conclusion is stems from the vulnerability of the boreal environment, the size of the project and results from other scientific studies conducted in Southern Quebec. However, uncertainty related to the risk assessment is high considering how little information is available on the local environment, monitoring measures agricultural practices and slurry management plan. Considering that Oujé-Bougoumou Eenuch Association and Waswanipi First Nation Cree Board of Health and Social Services are on record as being opposed to the project, two mains recommendations are listed below:

(i) To insist on receiving accurate and transparent information from the promoter and CDEC; and

(ii) To support an integrated, watershed-scale, management approach to ensure regional development viability.

However, the purpose and findings of this report should not be used to decide whether or not the pig farming project is "good" or "bad", but rather to provide relevant information to guide the actors and the promoters during their discussions at the upcoming public consultation. Considering the legal inability to question the relevancy of the project and the impacts on the environment, that being the task of the Expert Committee of QMDDEP, we list below second order recommendations, which might be considered following the potential project approval:

(iii) outline a socially acceptable distribution of risk, that is balance of undesirable impacts and benefits with the producer;

(iv) require an impartial and neutral monitoring organism through which local population could be involved; and

(v) call for commitments from the promoter to ensure the implementation of adapting measures and good agricultural practices (best management practices).