Table 3.2.6 Planned Composition – Flushes from the Cooling Water System

Parameter	
Total alkalinity (in the form of $CaCO_3$)	
Total aluminium	3.5 mg/l
Total arsenic (in the form of As)	0.014 mg/l
Bromine (from the biocide)	0.1 mg/l
Total cadmium (in the form of Cd)	0.07 mg/l
Total organic carbon	35 mg/l
Chloride	56 mg/l
Total chromium (in the form of Cr)	0.35 mg/l
Total cobalt (in the form of Co)	0.21 mg/l
Total copper (in the form of Cu)	0.14 mg/l
Cyanides (in the form of HCN)	0.07 mg/l
BOD	21 mg/l
COD	62 mg/l
Total iron (in the form of Fe)	3.0 mg/l
Total oil and grease/fat	10 mg/l
Total mercury (in the form of Hg)	0.0021 mg/l
Total nickel (in the form of Ni)	0.21 mg/l
Phosphate (in the form of PO_4)	0.56 mg/l
Lead (in the form of Pb)	0.7 mg/l
Dissolved solids	294 mg/l
Suspended solids	3.5 mg/l
Sulfates (in the form of SO_4)	7 mg/l
Total zinc (in the form of Zn)	0.07 mg/l
Silica	19.6 mg/l

3.2.4 Solid Discharges

3.2.4.1 *Iron Oxides*

Iron oxides are formed during the cyanide destruction process. They are then filtered from the solution. Colloidal iron oxides are sent to the red mud disposal site. An estimated 135 metric tons will be disposed of annually (67 t/year of dry material). The approximate composition of this waste is shown in Table 3.2.7.

Table 3.2.7 Colloidal Iron Oxide Waste – Approximate Composition

Compound	Percentage (weight)
Fe_2O_3	50%
H_2O	48%
NaOH	< 1%
NaF (in solution form)	1%
Al_2O_3 (in solution form)	< 1%

3.2.4.2 *Descaling Residues*

The descaling of equipment will generate solid waste that will be sent to the red mud disposal site. The annual amount of this waste to be disposed of is estimated at 100 metric tons.

3.2.4.3 *Carbon and Inert Materials*

The upgrading of solid products generated by the SPL processing plant will depend on available markets. In the current plant design, any carbon and inert materials recovered will be put in storage so they can be upgraded (refer to Section 3.4).

Table 3.2.8 shows the approximate quantities of solid wastes. All these wastes will undergo a quality analysis before being sent to the burial site (for iron oxides and descaling residues) or to storage (for carbon and inert materials).

Table 3.2.8 Solid Waste – Estimated Annual Quantities

Solid Discharges	Wet Materials	Dry Materials
Carbon and inert materials	65,000 MT	50,600 MT
Colloidal iron oxides	135 MT	67 MT
Equipment descaling residues	100 MT	50 MT

3.3 Supplies, Transportation and Traffic

3.3.1 Supply of Spent Pot Lining

Figure 3.3.1 is a diagram of the processing plant's global source of supply of spent pot lining when operating at full capacity (80,000 t). The source of supply diagram is based on the following considerations:

- Alcan will reduce the stockpile of pot lining stored at the Arvida warehouse in Jonquière (some 500,000 tons in total), at the same pace that these inventories were built up; this represents the use of 20,000 to 25,000 tons per year. The reduction rate of these inventories could fluctuate depending on the plant's capacity and the amount of new pot lining being generated in Alcan's Quebec plants.
- The pot lining being generated by Alcan's current activities across its six aluminium smelters in Quebec will be processed as it is being produced; the current average production of pot lining is estimated at 25,000 to 30,000 tons per year.
- Alcan is also expecting to process 5,000 tons of pot lining produced by one of its two plants outside Quebec; one of these plants is located in Kitimat, British Columbia, and the other in Sebree, Kentucky (USA). Alcan may decide to import the pot lining from one of these plants into Quebec, or the company may decide to exchange pot lining with another aluminium smelter in Quebec in order to reduce transportation costs for the two companies; a decision has not yet been taken in this regard.

These three components are central to the plant's source of supply and will ensure that it functions under normal operating conditions, which corresponds to a processing capacity of 60,000 tons of SPL each year. Alcan will accept pot lining from the other aluminium smelters in

Quebec, as long as the process performs sufficiently to generate more than 60,000 tons per year. Pot lining from other aluminium smelters in Quebec could also be accepted in those years when Alcan has lower production rates.

3.3.2 Transportation Requirements

Spent pot lining is the only raw material that requires transportation. In fact, caustic soda from the SLPP will be sent to the SPL processing plant through a pipe, and sulphuric acid will come from the Jonquière complex's sulphuric acid distribution network.

Of all the by-products generated by the SPL processing plant, only the solids will require transportation. The sodium fluoride solution will be transferred to the SLPP through a pipe. Calcium fluoride produced at the SLPP will be sent to the red mud disposal site through a pipe and via the mud washing circuit. The Bayer liquor will be transported to the hydrate plant at the Jonquière complex through a pipe.

3.3.2.1 *Supply Sources of Spent Pot Lining*

The pot lining generated by Alcan's ongoing operations comes from three pot lining removal centres, and will continue to do so: Arvida (receives pot lining generated in Jonquière, as well as that from Shawinigan and Beauharnois), Grande-Baie (receives pot lining from the Laterrière and Grande-Baie plants), and Alma. Pot lining production from the pot lining removal centre in Alma remains negligible right now because this aluminium smelter is not yet up-to-speed at removing pot lining. All the SPL being produced by Alcan is currently being shipped to Arvida by truck and temporarily stored in bulk in Building 308 of the industrial complex. Once this warehouse is full, the pot lining will be transferred to the long-term storage site on Alcan's properties.

Figure 3.3.2 shows the carrier modes that will be used to transport the SPL to the planned processing plant. There are two preferred carrier modes: rail transport and road transport.

Railway lines located inside Alcan's actual industrial complex are already serving the selected site. Shipping pot lining by railroad from the Grande-Baie and Alma pot lining removal centres, from the Alcan plants outside Quebec, and from the Bécancour and Deschambault aluminium smelters would likely be easy.

Road transportation would likely be reserved for transporting pot lining that is stored or produced at Arvida, since the distance is quite short. The Sept-Îles and Baie-Comeau aluminium smelters, if they were to become clients of Alcan's processing plant, would ship their pot lining by road.

Whether it be shipped by road or by rail, pot lining would arrive at the processing plant in containers. These containers are specifically designed to prevent the risk of explosion caused by pot lining's reactivity to water (refer to Figure 3.3.4). The pot lining will be stored in these containers at the SPL processing plant in a building reserved for this purpose until they can be processed.

The current practice of shipping the entire cells, by road or by rail, from the Laterrière (located in Chicoutimi), Shawinigan and Beauharnois aluminium smelters to the pot lining removal centres will continue. The pot lining will be placed in containers at the pot lining removal centres.

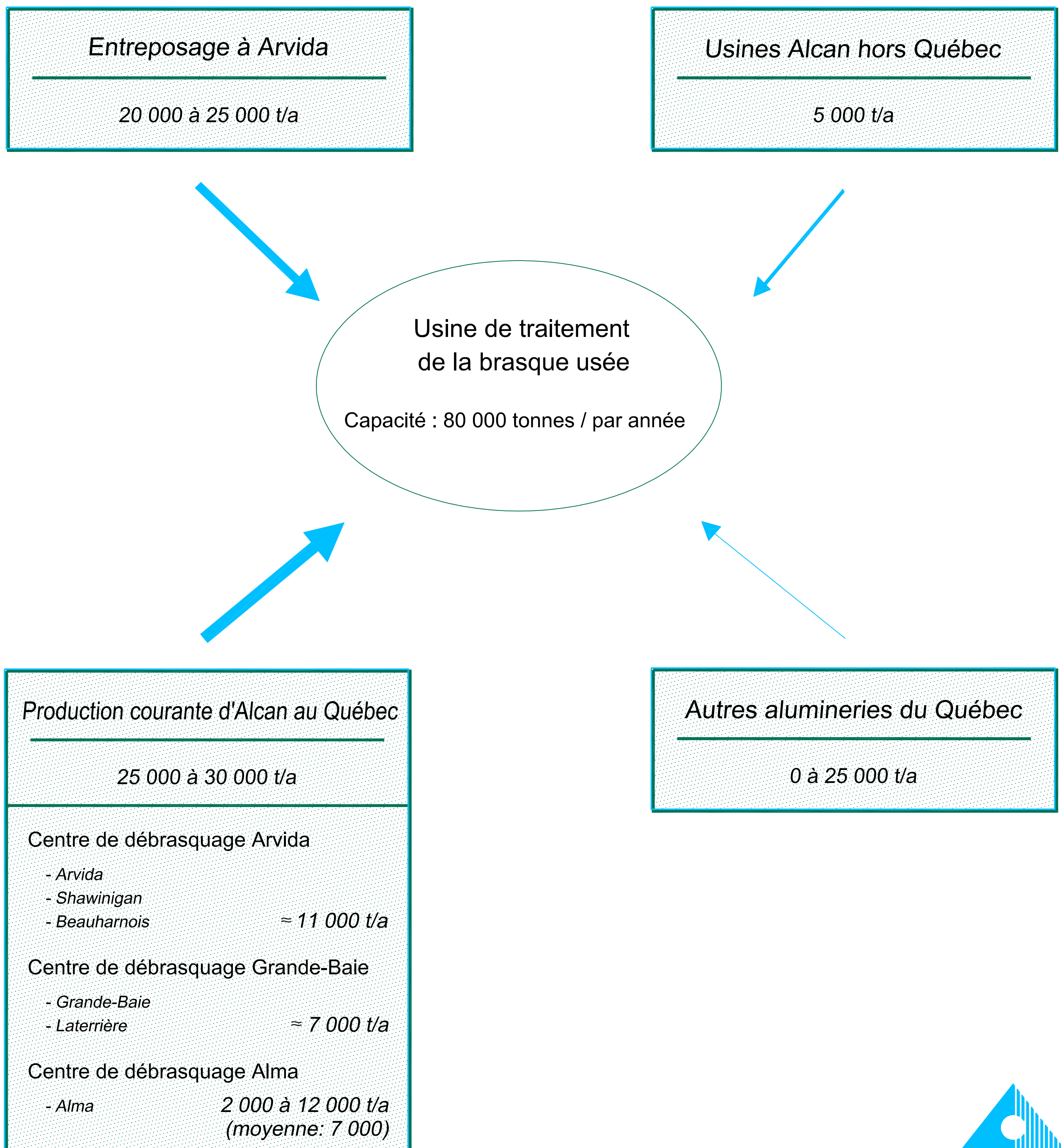
Figure 3.3.2 also shows the tonnage being shipped according to a scenario whereby 80,000 tons of pot lining are processed yearly. Given possible variations in the supply sources, there are several other possible scenarios. The scenario shown in Figure 3.3.2 was chosen because it maximizes the tonnage being transported by road. In this case, we assume that road transportation will cause more nuisances (noise, dust) than rail transportation. Based on this scenario, 29,000 tons will be transported annually by railroad, 15,000 tons will come from the Côte-Nord by way of the provincial road network before using the private roads on Alcan's properties, and 36,000 tons will travel across Alcan's properties annually.

The option of using sea transport as a means of moving supplies from other regions was not considered, since this mode of transportation involves larger volumes and demands larger storage capacities at each site, including the SPL processing plant. Furthermore, given the location of the planned site for the SPL processing plant, this option would require extra handling by truck or by train for the transhipment between the port area and the processing plant.

TECSULT

Sources d'approvisionnement en brasque usée

Figure 3.3.1

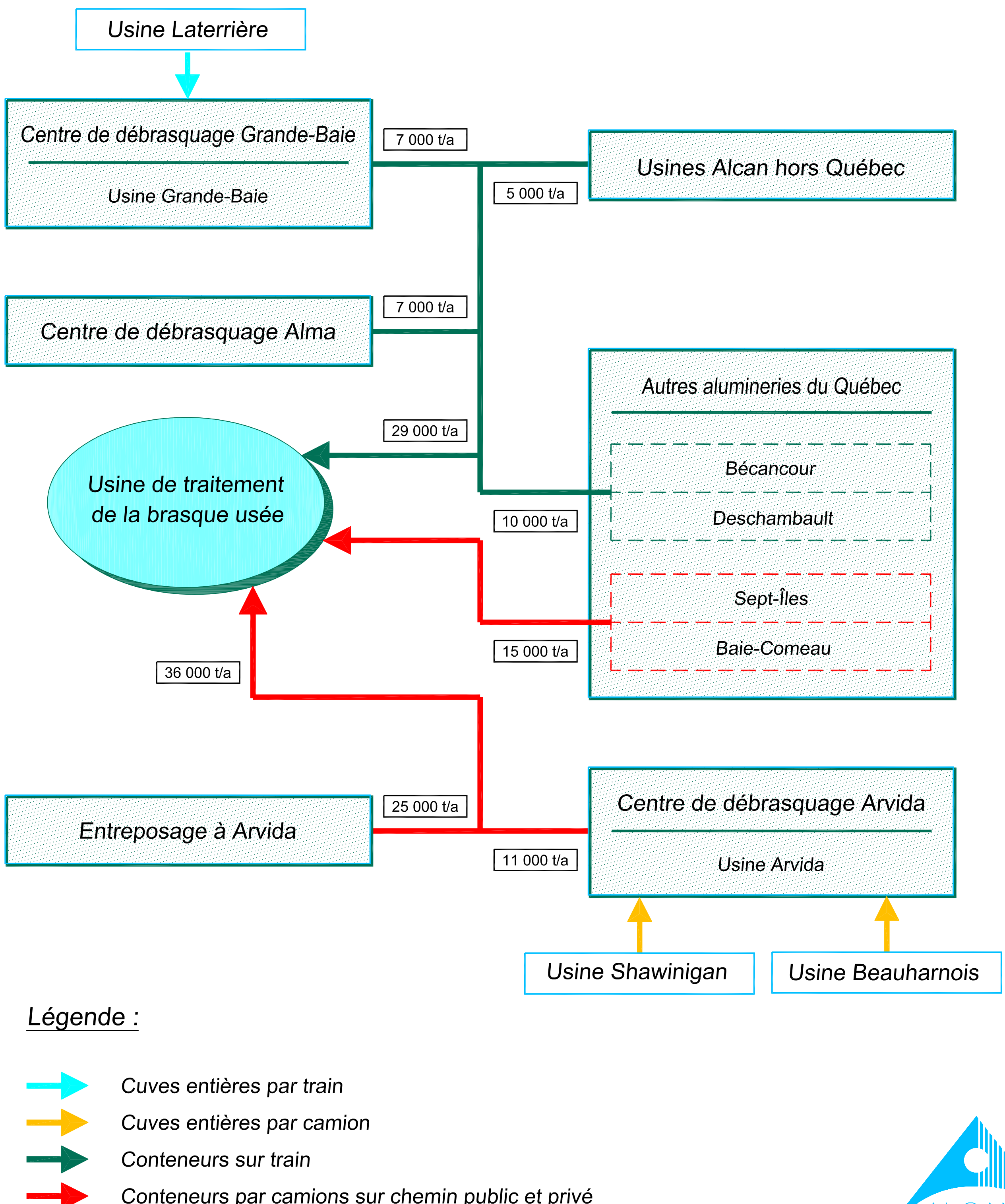


ALCAN

3.3.1 Correspondence Table

Entreposage à Arvida	Arvida storage site
20 000 à 25 000 t/a	20,000 to 25,000 t/year
Production courante d'Alcan au Québec	Alcan's current production in Quebec
25 000 à 30 000 t/a	25,000 to 30,000 t/year
Centre de débrasquage Arvida	Arvida Pot Lining Removal Centre
- Arvida	- Arvida
- Shawinigan	- Shawinigan
- Beauharnois	- Beauharnois
≈ 11 000 t/a	≈ 11,000 t/year
Centre de débrasquage Grande-Baie	Grande-Baie Pot Lining Removal Centre
- Grande-Baie	- Grande-Baie
- Laterrière	- Laterrière
≈ 7 000 t/a	≈ 7,000 t/year
Centre de débrasquage Alma	Alma Pot Lining Removal Centre
- Alma	- Alma
2 000 à 12 000 t/a	2,000 to 12,000 t/year
(moyenne : 7 000)	(average: 7,000)
Usine de traitement de la brasque usée	Spent Pot Lining Processing Plant
Capacité : 80 000 tonnes / par année	Capacity : 80,000 tons per year
Usines Alcan hors Québec	Alcan plants outside Quebec
5 000 t/a	5,000 t/year
Autres alumineries du Québec	Other aluminum smelters in Quebec
0 à 25 000 t/a	0 to 25,000 t/year

Modes de transport de la brasque usée — Figure 3.3.2



14041_Figure_3.3.2_2005-09_fm.dwg

3.3.2 Correspondence Table

Usine Laterrière	Laterrière Plant
Centre de débrasquage Grande-Baie	Grande-Baie Pot Lining Removal Centre
Usine Grande-Baie	Grande-Baie Plant
Centre de débrasquage Alma	Alma Pot Lining Removal Centre
Usine de traitement de la brasque usée	Spent Pot Lining Processing Plant
36 000 t/a	36,000 t/year
Entreposage à Arvida	Arvida storage site
7 000 t/a	7,000 t/year
5 000 t/a	5,000 t/year
7 000 t/a	7,000 t/year
29 000 t/a	29,000 t/year
10 000 t/a	10,000 t/year
15 000 t/a	15,000 t/year
25 000 t/a	25,000 t/year
11 000 t/a	11,000 t/year
Usines Alcan hors Québec	Alcan plants outside Quebec
Autres alumineries du Québec	Other aluminum smelters in Quebec
Bécancour	Bécancour
Deschambault	Deschambault
Sept-Îles	Sept-Îles
Baie-Comeau	Baie-Comeau
Centre de débrasquage Arvida	Arvida Pot Lining Removal Centre
Usine Arvida	Arvida Plant
Usine Shawinigan	Shawinigan Plant
Usine Beauharnois	Beauharnois Plant
Légende :	Legend:
Cuves entières par train	Entire cells by train
Cuves entières par camion	Entire cells by truck
Conteneurs sur train	Containers by train
Conteneurs par camions sur chemin public et privé	Containers by truck on public and private roads

The following table shows the transportation requirements generated by the SPL supply sources based on the selected scenario. The calculations are based on the fact that each container (refer to Figure 3.3.4) has an 18,000 metric ton capacity. A truck can only transport one container per trip, while a railroad car can carry three containers at once.

Table 3.3.1 Transportation Requirements Generated by the Spent Pot Lining Supply Sources

Train	**Tons/year**	**Cars/year**
Grande-Baie	7,000	130
Alma	7,000	130
Alcan outside Quebec	5,000	93
Bécancour	5,000	93
Deschambault	5,000	93
Total	*29,000*	*539*
Truck	**Tons/year**	**Trucks/year**
Arvida warehouse	25,000	1,389
Arvida	11,000	611
Sept-Îles	7,500	417
Baie-Comeau	7,500	417
Total	*51,000*	*2,834*

Five hundred and thirty nine railroad cars represent a small percentage of the railway traffic generated by Alcan's facilities in Jonquière. In fact, the industrial complex receives five trains daily, six days a week. Each train is composed on average of three engines and thirty cars, which is the equivalent of about 46,800 cars each year. The additional wagons only represent about 1.15% of the existing traffic. These cars would simply be inserted into the regular convoys.

With respect to trucks, only 834 trucks from the Côte-Nord would be travelling each year on the public transportation network. On average, anywhere from 4,000 to 5,000 vehicles travel in both directions daily on the section of Saguenay Boulevard located near the Alcan plant. The additional traffic represents only a negligible percentage of the existing traffic volume.

3.3.2.2 *Waste Disposal*

According to the plant's mass balance, the tonnage of solid waste that needs to be managed each year is as follows: carbon and inert materials (65,000 t), metallic iron (1,700 t), metallic aluminium (1,700 t), descaling residues (100 t), and colloidal iron oxide (135 t).

Carbon and inert materials are transported to Building 308 in the complex as they are produced, using trucks that can carry 18-ton containers. Two or three times each year, they will be transferred *en masse* to the storage site that will be developed on a plot of land in the eastern section of the Jonquière complex. The metallic aluminium is returned to the smelter for recycling, and the metallic iron rods are sent to the industrial complex's metal recycling centre. And finally, the other wastes - which amount to 235 tons - are sent to the red mud disposal site using conventional trucks.

Table 3.3.2 shows the transportation requirements generated by the solid waste.

Table 3.3.2 Transportation Requirements Generated by Solid Waste Disposal

Solid waste (bulk)	Tons/year	Trucks/year
Carbon and inert materials to Building 308	65,000	3,611
Carbon and inert materials to the storage site	65,000	3,250
Metallic aluminium	1,700	85
Metallic iron	1,700	85
Descaling residues	100	5
Colloidal iron oxides	135	7
Total	133,635	7,043

3.3.3 Distribution of Travel on Transportation Networks

The supplies of SPL arriving by train represent 539 cars per year, which in turn represents about 1% of the railway traffic generated by the industrial complex. At this point, we are not expecting any convoys to be reserved specifically for the transport of SPL. The SPL will arrive at the processing plant at regular intervals on regular convoys.

The situation is somewhat different when it comes to trucking. Normal conditions, which prevail for 48 weeks each year, must be distinguished from peak-period conditions, during which the carbon and inert materials are transferred from Building 308 on the industrial complex to the storage site. During this peak period, 20-ton trucks work from 7 a.m. to 5 p.m., for 5 or 6 days a week, over a two-week period. This event occurs twice yearly, in the spring and fall.

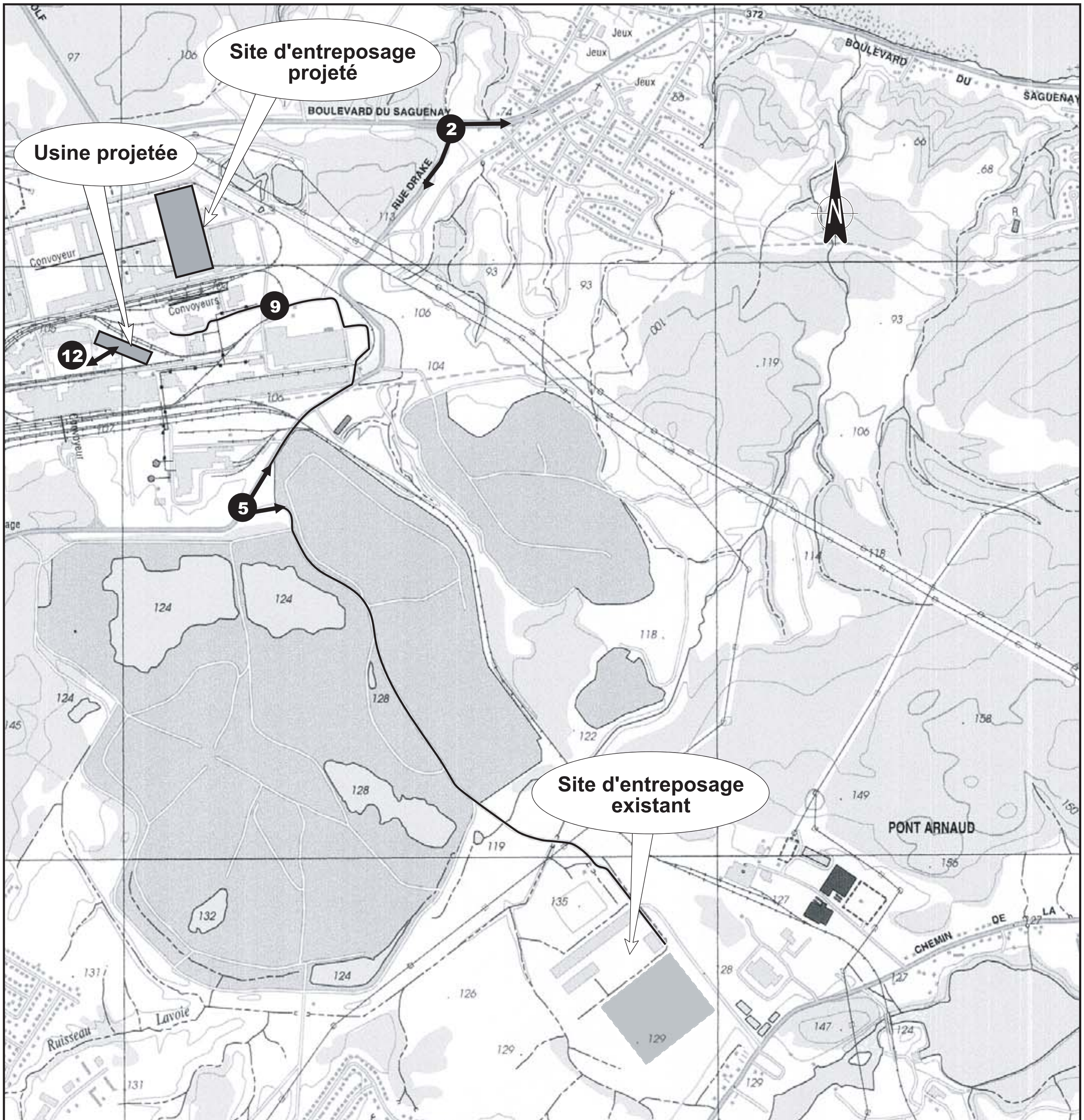
Table 3.3.3 shows the number of trucks circulating during a normal day of operations at the SPL processing plant, and the number circulating when both the plant and the carbon and inert material storage site are in operation. Over the course of a normal day, 46 vehicles at most will travel to and from the plant (23 trips “going” and 23 trips “coming back”). During the peak period, this number increases to 342.

Figure 3.3.3 shows the movement of this traffic. There will also be an estimated two trucks daily from the Côte-Nord that arrive at the plant by way of Route 172, the Dubuc Bridge in Chicoutimi, Saguenay Boulevard and Drake Street. The passage of these two trucks depends on whether or not Alcan is contracted to process the SPL generated by aluminium smelters in the Côte-Nord.

All other travel occurs inside the Alcan properties on private roads, including the short 1 km section on Drake Street, which belongs to Alcan and has no houses on it.

Table 3.3.3 Number of Trucks Circulating on a Normal Day and a Peak Day

Description	Trucks/year	Trucks/day Normal	Trucks/day Peak
Spent pot lining			
Arvida warehouse	1,389	5	5
Arvida	611	2	2
Sept-Îles	417	1	1
Baie-Comeau	417	1	1
Solid waste (bulk)			
Carbon and inert materials to Building 308	3,611	12	N/A
Carbon and inert materials to the storage site	3,250	0	160
Metallic aluminium	85	1	1
Metallic iron	85	1	1
Descaling residues	5	N/A	N/A
Colloidal iron oxides	7	N/A	N/A
Total	9,654	23	171



LÉGENDE :

9 — Nombre de camions lors d'un jour normal d'opération

ÉCHELLE 1 : 20 000

0 0,5 1,0 Km

ALCAN

AFFECTATION DES DÉPLACEMENTS SUR LE RÉSEAU ROUTIER

TECSULT

PROJET : **14041**

DATE : **Septembre 2005**

FIGURE : **3.3.3**

14041-3.3.3.ai (15/09/05) pc_cm

3.3.3 Correspondence Table

Usine projetée	Proposed plant
Site d’entreposage projeté	Proposed storage site
Convoyeur	Conveyor
Rue Drake	Drake Street
Boulevard du Saguenay	Saguenay Boulevard
Site d’entreposage existant	Existing storage site
Pont Arnaud	Pont Arnaud
Légende :	Legend:
Nombre de camions lors d’un jour normal d’opération	Number of trucks during a normal day of operations
Échelle 1 : 20 000	Scale 1:20,000
0 – 0,5 – 1,0 Km	0 – 0.5 – 1.0 km

TECSULT

Figure 3.3.4
Conteneur utilisé pour le transport de la brasque

Photo N°1

Photo N°2

14041-3.3.4.ai (15/09/05) pc_cm

3.3.4 Correspondence Table

Conteneur utilisé pour le transport de la brasque	Container used to transport pot lining
Photo N° 1	Photograph No. 1
Photo N° 2	Photograph No. 2

3.4 Carbon and Inert Material Storage Site

3.4.1 Background

The main by-product being generated by SPL processing is a solid composed of carbon and inert materials. The objective during the development of the SPL processing project is to upgrade this by-product, which could be used in cement factories because of its carbon content. However, potential clients need to test significant quantities of this product over long periods of time to determine whether it is suitable for their process and to decide to what degree they want to use it on a regular basis. For this reason, the SPL processing plant project includes the development of a storage site for this by-product, which has a storage life of five years. This is considered to be a sufficient amount of time to develop the market for the carbon and inert materials.

Given the expected characteristics of this by-product generated during the processing of pot lining by way of the LCLL process, the chances of being able to upgrade it are considered good. Consequently, for the requirements of the environmental impact assessment, all the carbon and inert materials generated over the first five years of the SPL processing plant's operations will be sent to the storage site. The storage site will be designed so that the waste is contained.

3.4.2 Site Description

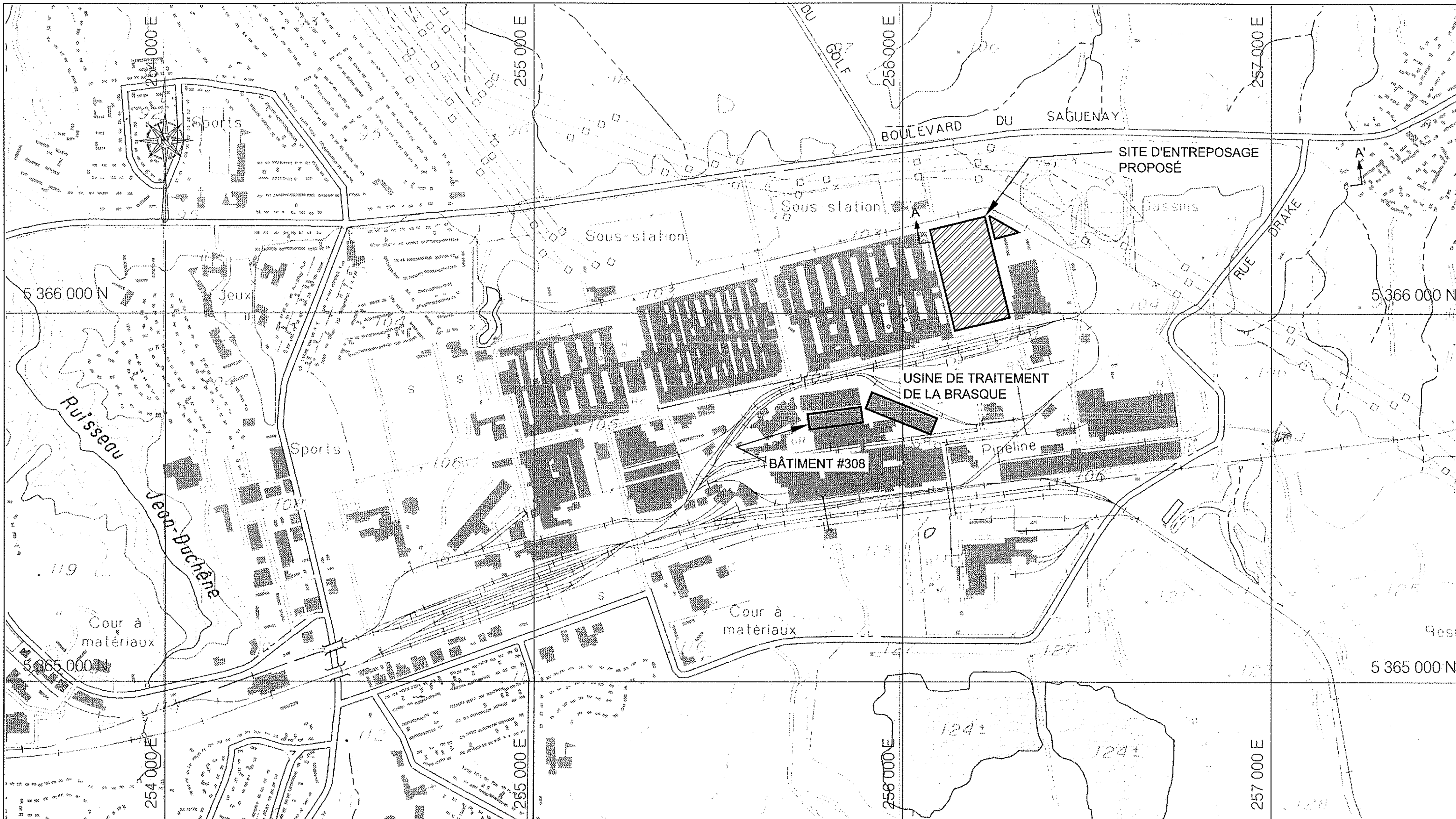
The site selected for the temporary storage of carbon and inert materials is located on a plot of land at the Arvida plant that was previously occupied by the buildings housing the series of electrolytic cells numbered 54 to 57 (refer to Figure 3.4.1). The available area is 155 m by 235 m, which includes a 5 m clearance from the existing buildings (refer to Figure 3.4.2).

According to available information, the site's stratigraphy is composed of (from top to bottom):

- 15 cm of top soil;
- 60 cm of sandy gravel;
- cement foundations from the cells and buildings that have now been demolished.

3.4.3 Description of Development

The proposed cell is surrounded by a dike that is composed of granular material (GM) and has been sealed with a geomembrane and a bentonitic geocomposite (refer to Figures 3.4.3 and 3.4.4). The storage space consists of a layer of bituminous concrete at the bottom of the cell, which is intended to facilitate the placement, and later, the removal, of waste, by providing a resistant and relatively smooth surface, while still allowing trucks to circulate.



Source :

Fond dessin extrait cartographique 1 / 20 000
Ministère des Ressources naturelles
feuillet 22D06 - 200 - 0202

PRÉLIMINAIRE

0 100 500m

ÉCHELLE GRAPHIQUE

ALCAN - COMPLEXE JONQUIÈRE

ALCAN

TECSULT

Tecsult Inc.
experts-conseils/consultants
MONTRÉAL, CANADA

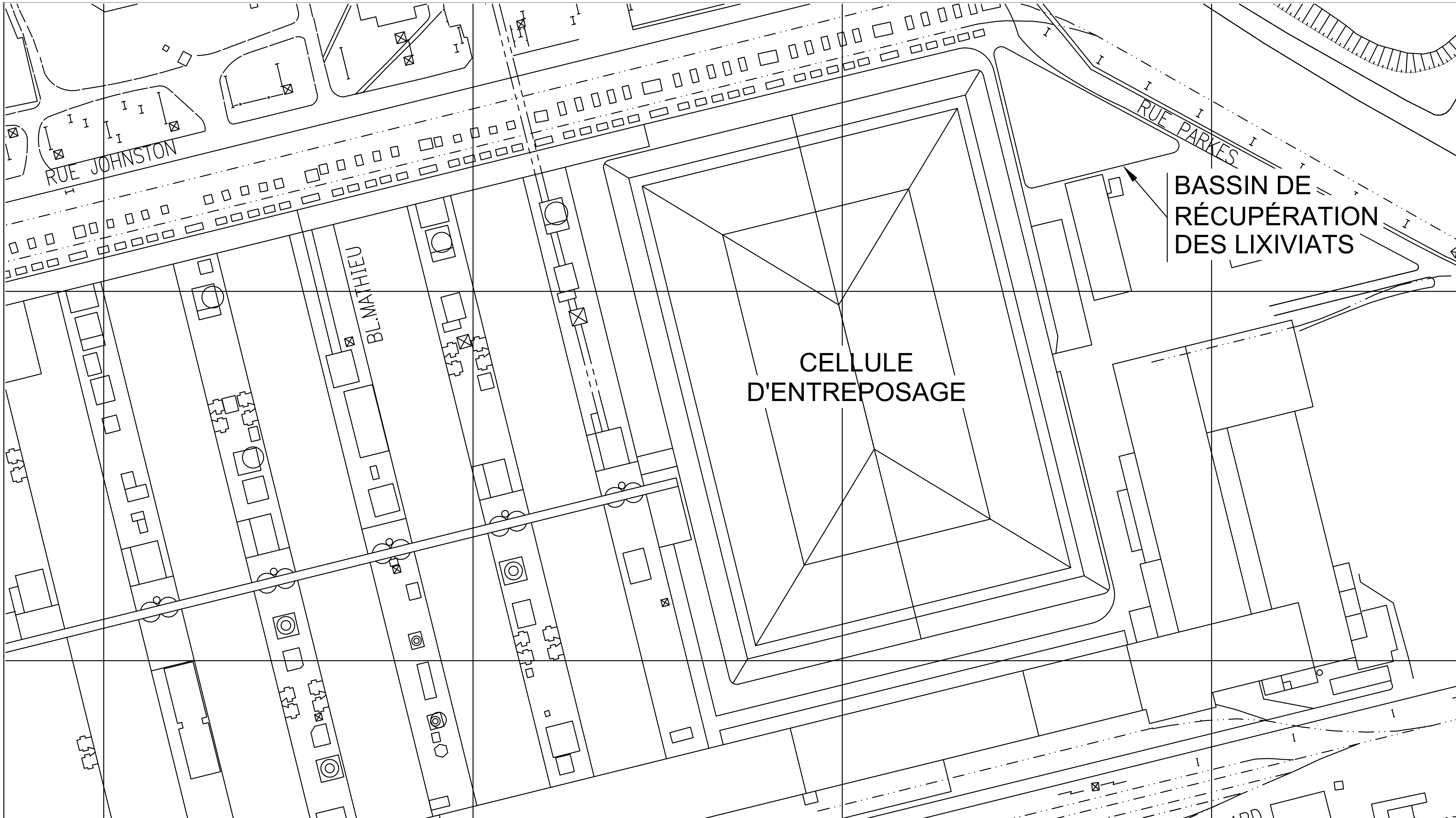
PLAN DE LOCALISATION GÉNÉRAL

Dessiné par	Vérifié par	Échelle	Date	N° contrat	
F.M. / D.G.	J. Marcotte	1 : 10 000	Jul. 2005	1 4 0 4 1	FIGURE 3-4-1

V:\14041 Alcan Jonquière\Chapitre 3\Fig 3-4-1.dwg

3.4.1 Correspondence Table

Boulevard du Saguenay	Saguenay Boulevard
Site d'entreposage proposé	Proposed storage site
Rue Drake	Drake Street
Usine de traitement de la brasque	Spent Pot Lining Processing Plant
Bâtiment 308	Building 308
Ruisseau Jean-Duchêne	Jean-Duchêne Creek
Source :	Source:
Fond dessin extrait cartographique 1 / 20 000	Illustration background extracted from a map 1 / 20,000
Ministère des Ressources naturelles	Ministère des Ressources naturelles
Feuillet 22D06-200-0202	Sheet 22D06-200-0202
Préliminaire	Preliminary
Échelle graphique	Linear scale
Alcan – Complexe Jonquière	Alcan – Jonquière Complex



Sources :

Fond dessin extrait dessin A0 159032 AC R07
Plan d'ensemble des bâtiments - revision sept. 1995
Cegertec inc. experts-conseils

Cartographie numérique basée sur photos aérienne mai 1994
Société Géocarto-Numérique C T inc.

ALCAN - COMPLEXE JONQUIÈRE

TECSULT — Tecsult Inc. experts-conseils/consultants MONTRÉAL, CANADA

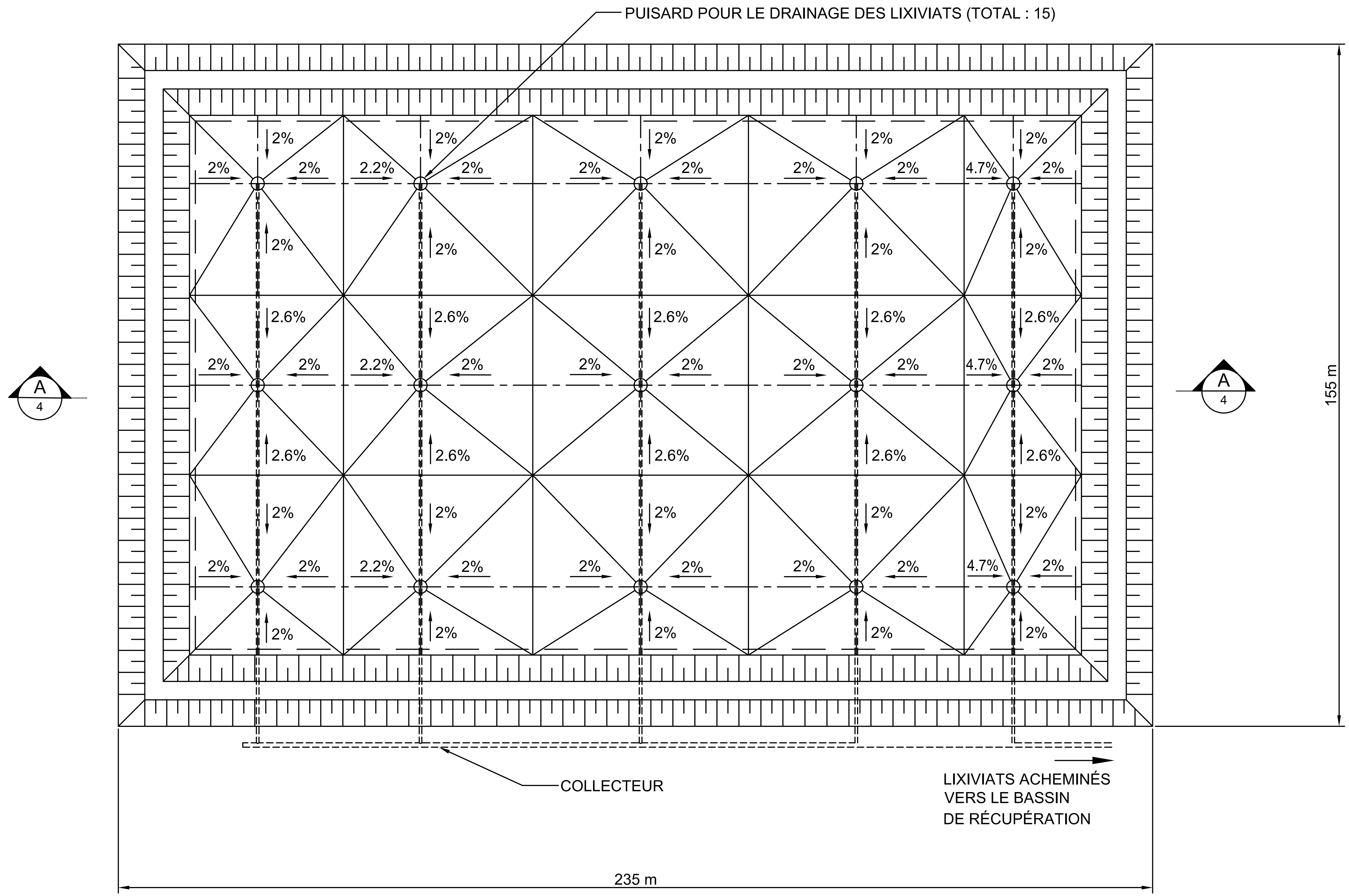
VUE EN PLAN DE L'AMÉNAGEMENT

Dessiné par	Vérifié par	Échelle	Date	N° contrat	FIGURE
F. Moisan	J. Marcotte	1 : 5 000	Sept. 2005	1 4 0 4 1	3-4-2

14041_Figure_3.4.2_2005-09_fm.dwg

3.4.2 Correspondence Table

Rue Johnston	Johnston Street
Bl. Mathieu	Mathieu Boulevard
Rue Parkes	Parkes Street
Bassin de récupération des lixiviats	Leachates recovery basin
Cellule d'entreposage	Storage cell
Sources :	Sources:
Fond dessin extrait dessin A0 159032 AC 907	Illustration background extracted from map A0 159032 AC 907
Plan d'ensemble des bâtiments – révision sept. 1995	Overall building plan – Revised September 1995
Cegertec inc. experts-conseils	Cegertec inc. experts-conseils
Cartographie numérique basée sur photos aérienne - mai 1994	Digital mapping based on aerial photographs – May 1994
Société Géocarto-Numérique C T inc.	Société Géocarto-Numérique C T inc.
Échelle graphique	Linear scale
Alcan – Complexe Jonquière	Alcan – Jonquière Complex



PRÉLIMINAIRE

ALCAN - COMPLEXE JONQUIÈRE

TECSULT

Tecsult Inc.
experts-conseils/consultants
MONTRÉAL, CANADA

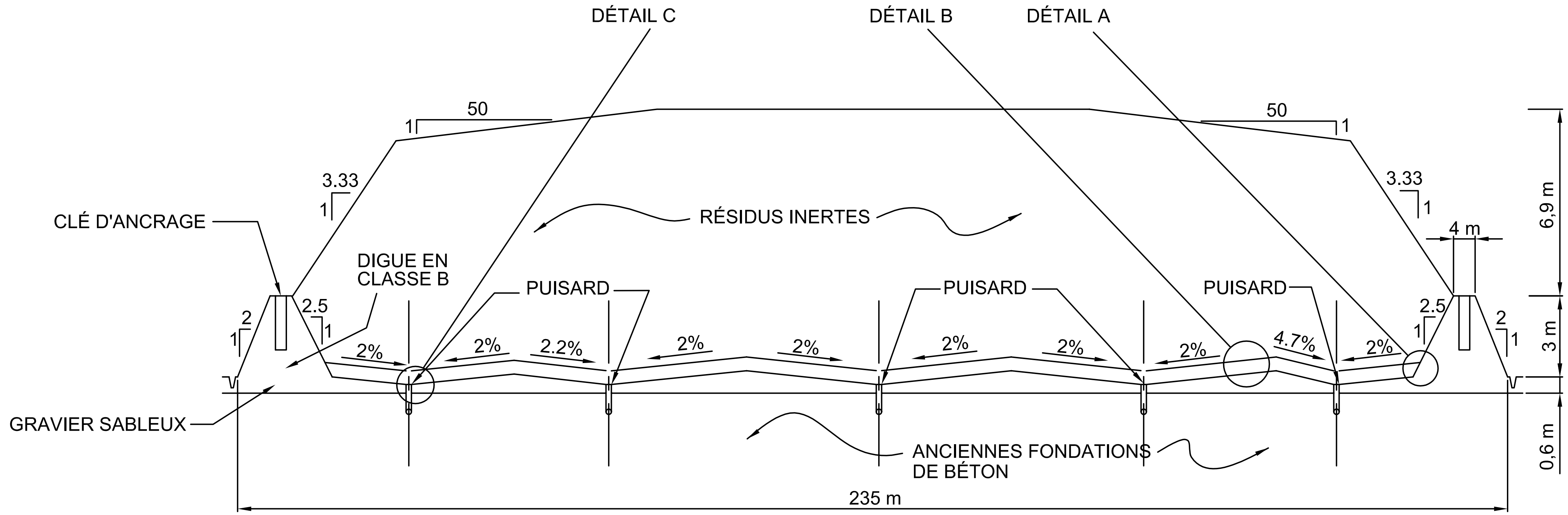
VUE EN PLAN DE LA
CELLULE D'ENTREPOSAGE (VIDE)

Dessiné par	Vérifié par	Échelle	Date	N° contrat	FIGURE
D. Sobierajski	J. Marcotte	1 : 1 000	Sept. 2005	1 4 0 4 1	3-4-3

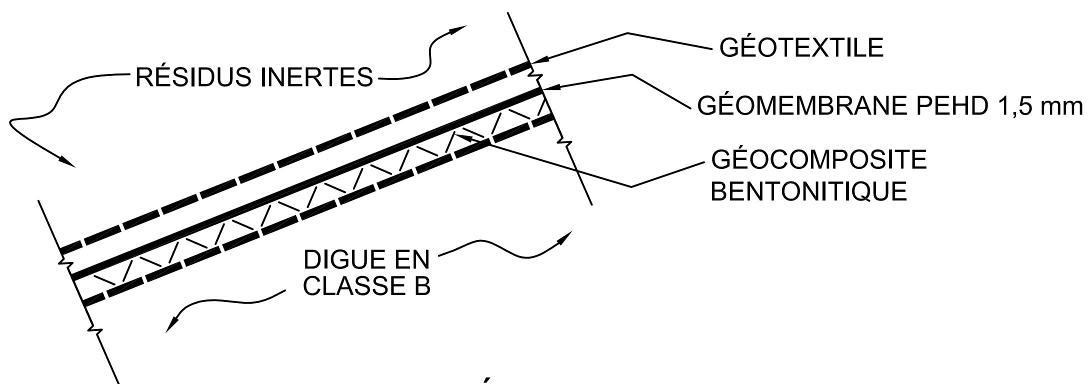
14041_Figure_3.4.3_2005-09_fm.dwg

3.4.3 Correspondence Table

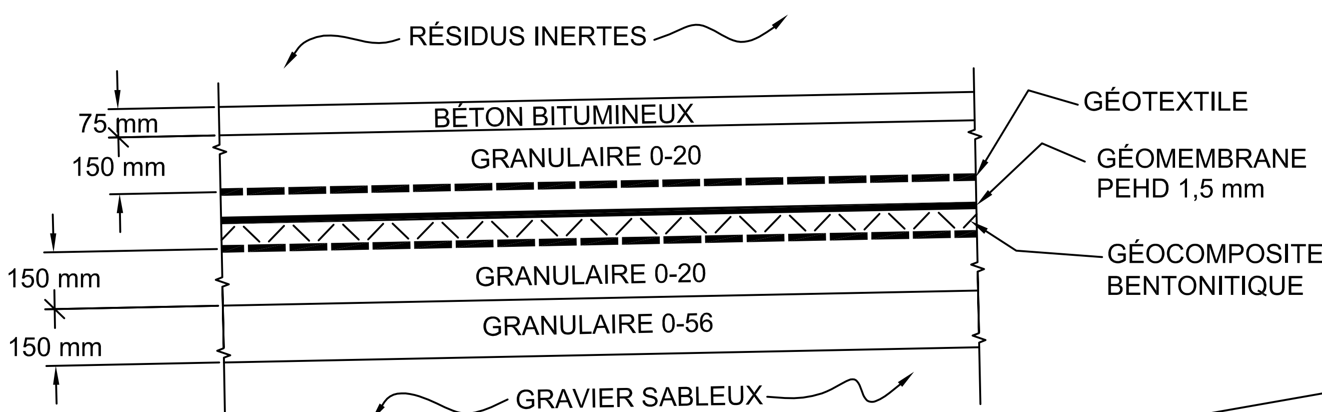
Puisard pour le drainage des lixiviats (total : 15)	Catch basin to drain leachates (Total: 15)
Collecteur	Collecting sewers
Lixiviats acheminés vers le bassin de récupération	Leachates being sent to the recovery basin
Préliminaire	Preliminary
Alcan – Complexe Jonquière	Alcan – Jonquière Complex



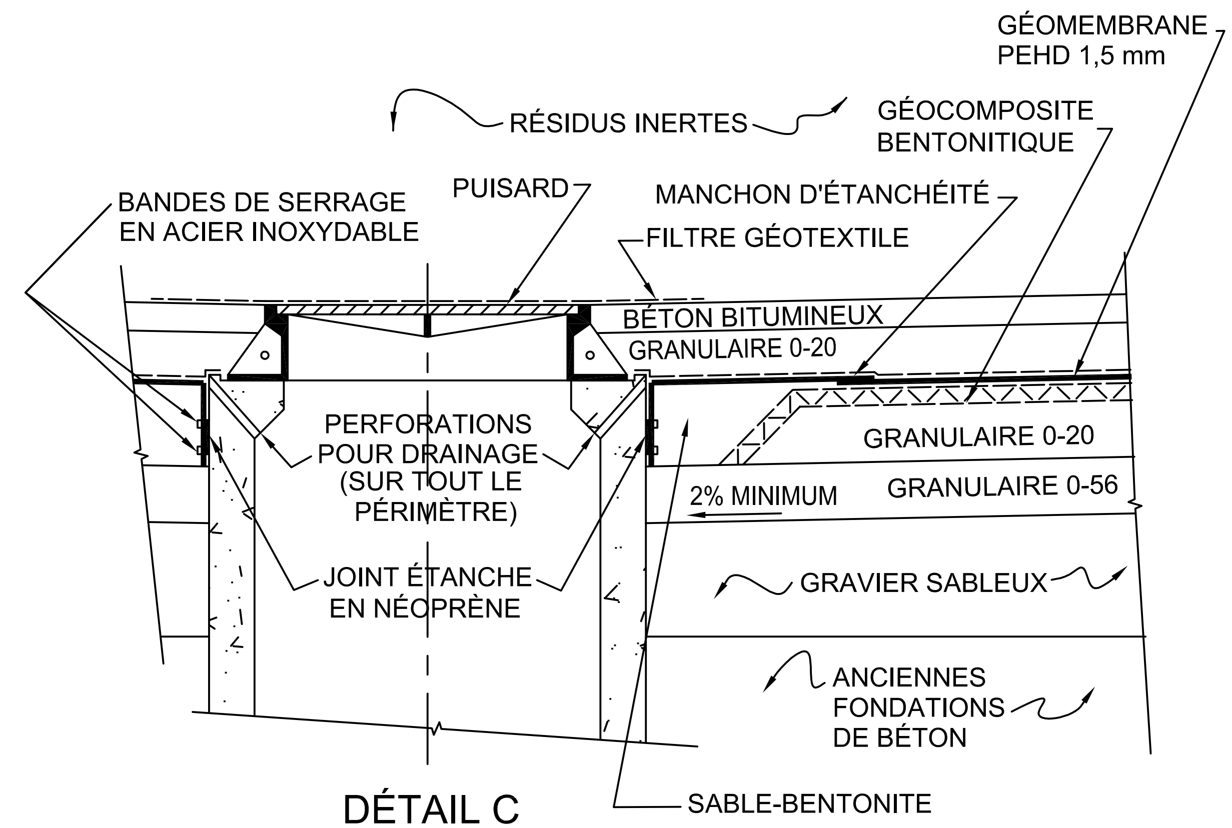
COUPE A/3



DÉTAIL A
P.À.É.



DÉTAIL B
P.À.É.



DÉTAIL C
P.À.É.

PRÉLIMINAIRE

ALCAN - COMPLEXE JONQUIÈRE				COUPE-TYPE DE LA CELLULE D'ENTREPOSAGE
TECSULT — Tecsult Inc. experts-conseils/consultants MONTRÉAL, CANADA				
Dessiné par: D. Sobierajski	Vérifié par: J. Marcotte	Échelle: 1 : 1 000 HOR, 1 : 200 VER	Date: Sept. 2005	N° contrat: 1 4 0 4 1 — FIGURE 3-4-4

14041_Figure_3.4.4_2005-09_fm.dwg

3.4.4 Correspondence Table

Détail C	Detail Drawing C
Détail B	Detail Drawing B
Détail A	Detail Drawing A
Clé d'ancrage	Anchoring key
Digue en classe B	Class B Dike
Résidus inertes	Inert wastes
Puisard	Catch basin
Puisard	Catch basin
Puisard	Catch basin
Gravier sableux	Sandy gravel
Anciennes fondations de béton	Old cement foundations
Coupe A-3	Cross Section A-3
Résidus inertes	Inert wastes
Géotextile	Geotextile
Géomembrane PEHD 1,5 mm	High-density polyethylene geomembrane – 1.5 mm
Géocomposite bentonitique	Bentonitic geocomposite
Digue en classe B	Class B Dike
Détail A (P. À. É.)	Detail Drawing A
Bandes de serrage en acier inoxydable	Stainless steel fastening bands
Résidus inertes	Inert wastes
Puisard	Catch basin
Géomembrane PEHD 1,5 mm	High-density polyethylene geomembrane – 1.5 mm
Géocomposite bentonitique	Bentonitic geocomposite
Manchon d'étanchéité	Sealing sleeve
Filtre géotextile	Geotextile filter
Béton bitumineux	Bituminous concrete
Granulaire 0-20	Granular 0-20
Perforations pour drainage (sur tout le périmètre)	Drainage perforations (across the entire edge)
Joint étanche en néoprène	Neoprene waterproof joint
Granulaire 0-20	Granular 0-20
Granulaire 0-56	Granular 0-56
2% minimum	2% minimum
Gravier sableux	Sandy gravel
Anciennes fondations de béton	Old cement foundations
Sable-bentonite	Sand-bentonite mixture
Détail C (P. À. É.)	Detail Drawing C
Résidus inertes	Inert wastes
Béton bitumineux	Bituminous concrete
Granulaire 0-20	Granular 0-20
Granulaire 0-20	Granular 0-20
Granulaire 0-56	Granular 0-56
Gravier sableux	Sandy gravel
Détail B (P. À. É.)	Detail Drawing B

Géotextile	Geotextile
Géomembrane PEHD 1,5 mm	High-density polyethylene geomembrane – 1.5 mm
Géocomposite bentonitique	Bentonitic geocomposite
Préliminaire	Preliminary
Alcan – Complexe Jonquière	Alcan – Jonquière Complex

As indicated in Figure 3.4.4, the bottom of the cell is sitting directly on sandy gravel and is composed of (from the bottom to the top):

- 150 mm of GM 56;
- 150 mm of GM 20;
- 1 bentonitic geocomposite;
- 1 high-density polyethylene geomembrane of at least 1.5 mm;
- 1 protective geotextile;
- 150 mm of GM 20;
- 75 mm of bituminous concrete.

The interior slopes of the dike are covered with a bentonitic geocomposite, a geomembrane, and a geotextile (refer to Figure 3.4.4).

3.4.4 Construction Phases

The cell will be constructed in five (5) phases, based on the tonnage of carbon and inert materials that will be generated during the first five (5) years of the cell's operations.

There are several advantages to building the cell in five (5) phases:

- in case of rapid development of a market for the pot lining waste, the company can avoid building an oversized cell;
- it is easier to manage surface runoff water and leachates by minimizing the surfaces exposed to precipitation; and
- one of the cell's extremities remains open during the first four (4) years of operation, which facilitates access by trucks and other worksite vehicles.

As shown in Figures 3.4.3 and 3.4.4, the cell's bottom was divided into five (5) rows of three pits. The length of these rows varies and was established based on the quantities of carbon and inert materials that will be generated during the first five years of the SPL processing plant's operation. A 10 m buffer between the foot of the waste heap and the top of the pits was considered.

3.4.5 Waste Storage

It is expected that pot lining waste will be stored daily in an existing building. However, the waste will be transported to the cell three (3) times each year during the anticipated five-year operational period. The waste will be placed and compacted into peripheral slopes of 1V:3.33H then in 1V:50H, for a total height of about 9.9 m (refer to Figure 3.4.4).

The procedure for filling the cell will be as follows:

1. During the first four years of operation, trucks will go directly to the bottom of the cell by way of its open extremity.
2. Trucks will dump the waste directly onto the bottom of the cell, a few metres from the foot of the waste heap that has already been placed in storage (over the first four years), or from the top of the cell in the last year.

3. To prevent trucks from coming into contact with the waste, a hydraulic shovel will transfer piles of dumped waste onto the heap.
4. A bulldozer will even out the waste into thin layers, which will facilitate the compacting step.
5. The waste heap will gradually be shaped into 3.33H:1V slopes and then 50H:1V slopes (refer to Figure 3.4.4).
6. The newly created heaps will be temporarily covered with a geomembrane in order to limit the quantity of leachates to be processed (refer to Sub-section 2.5).
7. In the fifth year, the surrounding dike will be closed and ramps built to allow the trucks to dump their waste from the top of the dike. A hydraulic shovel and a bulldozer will be used to place and compact the waste.

The uncovered bituminous concrete must be cleaned periodically using a street sweeper to prevent the waste from spreading and to prevent its migration outside the cell (on truck wheels, for example).

The catch basins, which will be located at a sufficient distance from the front of the stored waste heap, would be temporarily plugged so that rainwater does not penetrate the leachate recovery system. Water accumulated from precipitation will be pumped periodically out of the cell, into the existing storm sewer system.

3.4.6 Covers

The waste will be permanently covered using a high-density polyethylene geomembrane that is at least 1 mm thick in order to prevent water filtration and waste erosion from surface runoff waters. Newly stored waste will be covered with a temporary geomembrane after each intensive storage period.

The geomembrane covers should be ballasted to reduce the risk of them being lifted by the wind (berms or sand bags, tires, etc.). A collection system for surface runoff waters (not shown in the illustrations) will be set up near the top of the surrounding dike in order to channel these waters into the existing storm sewer system.

To prevent precipitation water from accumulating in the 10 m buffer zone at the foot of the waste heap while the waste is temporarily being covered, it is proposed that the foot of the heap be shaped to create a 2% slope facing the outside of the operating pit (refer to Figure 3.4.5). When the storage work starts up again, the geomembrane will be removed and any pot lining waste found in the buffer zone will be put back on the heap.

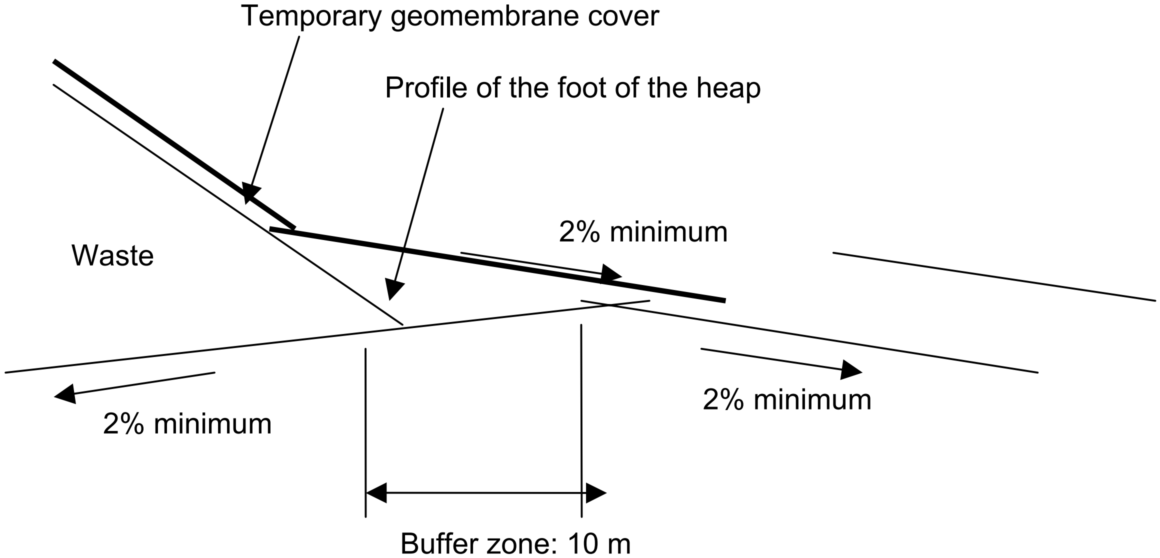


Figure 3.4.5 Detail Drawing - Profile of the Foot of the Waste Heap

3.4.7 Managing Leachates

As a result of all the precautions that have been taken, the volume of leachates generated is expected to be low. Nonetheless, the leachates are recovered using a watertight drainage system that resembles a conventional storm sewer network (catch basins, collecting sewers, etc.). The cell is divided into fifteen (15) pits, which are drained by the same number of catch basins (refer to Figure 3.4.3). Before being filled over, the catch basins will be covered with a geotextile filter to prevent waste from migrating into the leachate collection system.

As shown in Figure 3.4.4, installing a geomembrane sealing sleeve around the catch basins and laying down a sand-bentonite mixture will ensure the cell is watertight around the catch basins. The proposed configuration allows the upper layer of granular material (GM 20) to drain, by way of perforations drilled directly into the catch basins.

The leachates will be sent to a recovery basin (600 mm of argillaceous material and a 1.5 mm geomembrane) built outside the cell (refer to Figure 3.4.2). The leachates will be pumped into tank trucks for reuse in the SPL processing plant's process.

If we consider that snow accumulated on the site is removed in the spring (with snowblowers) to allow the storage activities to continue, the recovery basin is big enough for a rainfall with a 25-year return period (76.2 mm/day over the course of 1 day). If two (2) pits are in operation at the same time, the leachates recovery basin should have a minimum capacity of 310 m³.

3.4.8 Waste Recovery

During the recovery of wastes for upgrading purposes, ramps will be built to allow trucks to circulate on top of the dikes. Hydraulic shovels will be positioned on several levels and will be used to gradually lower the waste heap and to load the trucks.

Once the waste heap reaches the same height as the dikes, one of them could be opened to allow the trucks to pass. The last few metres of waste at the bottom of the cell could then be loaded using a front-end loader.

3.5 Decommissioning and Rehabilitating the Site

Technical planning for the SPL processing plant is based on a useful life of twenty years. At the end of this period, Alcan could consider maintenance or upgrading projects for its major equipment. These enhancements would occur in order to extend the plant's useful life and to respond adequately to the need to process and upgrade SPL, depending on the situation at that time.

If it were to be deemed necessary to dismantle the SPL processing plant and rehabilitate the site, these activities would be carried out according to procedures established for the eventual clean up and management of the demolition materials or soils.

The main activities related to the decommissioning and rehabilitation of the site would likely include the following:

- cleaning and decontamination of equipment, as required;
- dismantling of equipment;
- sorting of the various materials in order to identify those that can be reused or recycled;
- tearing down buildings;
- identifying opportunities to reuse and recycle the demolition materials;
- soil characterization;
- depending on the results of the characterization step, decontaminating the soils, if required, according to the intended usage for the site.

4 ALTERNATIVES AND IMPLEMENTATION METHODS

4.1 Project rationale

Alcan wishes to set up a spent pot lining treatment plant in the Jonquière Complex in Saguenay to process the hazardous material in spent pot lining resulting from current and past aluminum production operations. The selected technology has the potential for upgrading materials contained in spent pot lining and minimizing impacts on the environment. The project's expected treatment capacity is 80,000 tonnes of spent pot lining per year. This project will help provide a comprehensive, sustainable solution for the management of spent pot lining.

4.2 Background

4.2.1 Spent Pot Lining as a Hazardous Material

Pot lining is the interior coating of the electrolytic cells used to produce aluminium. This lining, which constitutes the cathode, is composed of insulating and refractory bricks and carbon blocks. While in use, this cathode absorbs a certain amount of the electrolyte's components throughout the electrolytic process. Since the cathode is exposed to both thermal and chemical stress, this interior lining of the electrolytic cells must be replaced after five to eight year's of use. The metal casing is often repaired and reused for another production cycle.

According to Quebec's *Regulation respecting hazardous materials (Q-2, r.15.2)*, spent pot lining is considered a hazardous material because it is leachable, and because it can, in certain conditions, generate a flammable and toxic gas. In fact, SPL contains leachable fluorides and cyanides, and the presence of various chemical products gives it properties that are reactive to water. The pot lining is also corrosive because of the presence of sodium compounds, which also raises the pH of any leachate. As a result, the transportation, storage and final repository of pot lining are all subject to specific environmental standards.

4.2.2 Current State of Spent Pot Lining Management in Quebec

Over the last decade, aluminium producers have made efforts to improve the linings of electrolytic cells and to extend their service life. For Alcan, improving the quality of cell linings has extended their lifespan by about 20%, which reduces the quantity of SPL being generated by the same amount. At the same time, the gradual replacement of cells using the old horizontal stud Söderberg technology with prebaked anode cells has helped to reduce the amount of SPL being generated for every ton of aluminium produced.

For even older low-amperage aluminium production technologies[7], the SPL generation rate is 35 kilograms per ton of aluminium produced. For newer technologies that operate at a high amperage, the SPL generation rate is about 22 kilograms per ton of aluminium produced. By replacing these old technologies with new ones, the company can potentially reduce its SPL generation rate by 30%.

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7 As an example, the amperage of Alcan's horizontal stud Söderberg cells is lower than 70,000 amperes, while the amperage for the new cells exceeds 300,000 amperes.

Nonetheless, some 55,000 tons of SPL are generated each year by Quebec's aluminium smelters. Nearly one-half of this tonnage comes from Alcan's aluminium smelters.

Since they first launched their operations, Quebec's other aluminium smelters have been shipping their SPL by truck or by train to the United States. Here the SPL is processed and buried at Alcoa's facilities in Gum Springs, Arkansas.

Until 1981, Alcan used SPL to produce cryolite. However, the market for cryolite dried up, and Alcan stopped its production in 1980. Since that date, Alcan has been shipping the pot lining (entire cells or just the SPL) by truck or by train to Jonquière or La Baie, where the company owns pot lining removal centres. The SPL is then safely stored in facilities designed specifically for that purpose in Jonquière.

From October 2001 to November 2003, after Quebec's Ministère de l'environnement prohibited the company to increase the amount of stored SPL in Jonquière, Alcan shipped the SPL generated by its current activities to the United States by train. Forty six thousand tons of SPL were shipped during that period. On October 31, 2003, Quebec's Ministère de l'Environnement issued an authorization amendment to Alcan concerning its storage activities. The amendment extended the storage time of roughly 517,000 tons of pot lining to November 31, 2008, and allowed the company to increase the amount of pot lining in storage, with the condition that all the stored pot lining be processed over a period not exceeding twenty years, starting from the launch date of an operationally stable pot lining processing plant.

4.3 Management Options

As with any other waste, the management of SPL can be illustrated using the following hierarchy:

- Reduction at the source;
- Reuse;
- Recycling;
- Upgrading; and
- Disposal.

4.3.1 Reduction at the Source

There are two facets to consider with reduction at the source: prolonging the lifespan of cells and changing the electrolysis technology. The aluminium industry, including Alcan, is constantly working to improve the lifespan of cells. The industry has thus moved from a cell lifespan of 1,500 days to now more than 2,500 days. As a result, the amount of SPL generated per ton of aluminium produced has decreased by as much. There is definitely an environmental benefit from this extended lifespan, but also an economic one, if we consider the cost of rebuilding an electrolytic cell.

Research also continues in order to modify the type of cathode being used. However, gains in this field will only be made, at best, in more than ten years, since the current lifespan of cells is from five to ten years.

4.3.2 Reuse

It is also possible to reuse one part of the SPL. One part of the carbon can be recovered, processed in vapour to make it less reactive, and reused as a “paste” for building a new cathode. This process is now being used at Alcan’s plant in Kitimat: the amount recycled, however, is very limited and the costs of reusing it are high.

4.3.3 Recycling

Recycling consists mainly of recovering the chemical value of the SPL, especially the fluoride. Until 1980, Alcan operated a plant for recovering cryolite (aluminium sodium fluoride). The plant was closed down after the market for cryolite dried up. Other high-temperature processes were tested in order to produce aluminium fluoride. None of these processes reached the industrial and commercial level.

4.3.4 Upgrading

The LCLL process is a hydrometallurgic recycling process, which means it works in a liquid phase at low temperatures. This process allows the company to recover both the chemical and calorific value of the pot lining. The LCLL process is considered to be an upgrading process.

The other upgrading processes are based for the most part on using SPL directly to replace carbon or a fuel. The production of cement and mineral wool using SPL were both tested. In addition to technical limitations, linked mostly to pot lining’s high sodium content, there are regulatory issues since SPL is classified as a residual hazardous material.

4.3.5 Disposal

And finally, SPL can also be stabilized and buried. There are two processes in this category: high-temperature vitrification and the Alcoa (Reynolds) process being used commercially in Gum Springs, Arkansas.

4.4 Technological Choices

4.4.1 Technologies Being Contemplated

Several processes or techniques were developed in order to find a more permanent solution for the management of SPL. Alcan created a work group in 1991 with a mandate to identify SPL processing technologies (Grolman, 1994). The following criteria were used to choose the technology:

- technical feasibility;
- costs (capital and operations);
- waste production;
- tolerance for variations in the pot lining’s composition; and
- potential of upgrading the waste.

The different techniques for processing SPL were reviewed and summarized in two publications (Grolman, 1994 and Kimmerle, 1994). There are two broad categories of technologies for processing SPL: pyrometallurgical processes and hydrometallurgical processes.

4.4.1.1 *Pyrometallurgical Processes*

Pyrometallurgical processes are mainly intended to destroy the cyanides and reactive compounds and to reduce the solubility or immobilize the other substances contained in SPL.

The processes being used by the three SPL processing units currently in operation in North America belong to this family of processes.

Alcoa (previously Reynolds) has a commercial SPL processing unit in Arkansas in the United States. The pot lining is processed at a temperature of almost 900°C in a rotary kiln where lime and additives are mixed in. According to American regulations, the post-processing product is still considered to be hazardous and is sent for burial. What is more, it weighs about 2.4 times more than the pot lining's initial weight going into the process.

Vortec's vitrification unit is used exclusively to process pot lining from the Ormet aluminium smelter in Ohio. This unit's processing capacity is limited to about 5,000 tons per year. The Vortec process involves high-temperature incineration. The crushed pot lining is mixed with clay, silica and limestone, and is used to fire a shaft kiln. There does not seem to be a very promising market for the glass pellets produced by this process. Gaseous emissions from the incineration process must be treated.

Nova Pb developed the CalSiFrit process in 2001. In June 2002, the company obtained a temporary operating licence from Quebec's Ministère de l'Environnement to produce a vitrified siliceous matrix called glass frit from SPL at its Ville Ste-Catherine facilities. The commercial operation was launched in 2003. The SPL is mixed with additives and reagents and is fed into a rotary kiln. Once it exits the kiln, the vitrified material goes through a secondary glass finishing furnace where the part containing carbon is separated by gravity. The process generates two products: 1) CalSiFrit, in the form of black glass pellets, which can be used as a cement additive, and 2) CalSiCoke, which could be used in specific applications (i.e. cement factories and steel works), especially as an alternative fuel, if its composition (and specifically its sodium content), and the increased quantities to be disposed of, do not compromise such possibilities.
Other possible pyrometallurgical processes exist but have never reached the implementation stage:

- In the Pechiney process (SPLIT), the fluorides are stabilized by reaction with calcium sulphate ($CaSO_4$). In this case, the amount of material to be buried after processing represents about 2.2 times the initial weight of the SPL processed;
- High-temperature incineration in a cement kiln, in steel production or other industrial processes where the pot lining constitutes a source of energy and raw materials, is technically possible. In a cement factory, the carbonated part of the pot lining can be used as fuel, while the refractory part may represent a source of alumina. However, the high alkali content of the SPL may have a negative effect on the quality of the clinker produced. Consequently, since the advantages of this option are limited, the regulatory constraints related to obtaining authorization to use a hazardous material and the technical constraints both make this option unappealing;

- High-temperature incineration using a plasma gun or in a cupola was also considered. This process requires that significant quantities of lime, which generate slag, be added. Incineration produces particulate emissions of HF and SiF_4. As is the case with other types of thermal processing, the waste being generated may contain fluorides that are leachable under certain conditions (Grolman, 1994);
- Processes based on pyrolysis, calcination or combustion that are combined with chemical stabilization eliminate cyanides and reduce the leaching rate of soluble fluorides. Materials that are processed in this way must then be buried. Studies have shown that, depending on pH conditions, the materials processed in this way could, however, show elevated rates of fluoride leaching (Grolman, 1994).

4.4.1.2 *Hydrometallurgical Processes*

The goal of hydrometallurgical processes for SPL is to recover the products or chemical elements contained in pot lining and to obtain a waste for which the leachate contains low concentrations of fluorides and cyanides.

There are currently no commercial operations for hydrometallurgical processes used to treat SPL.

The LCLL process (Low Concentration Caustic Leach and Liming) developed by Alcan is a hydrometallurgical process that combines various simple and relatively well-known operations. These various operations are being used or were already being used independently on different occasions in Alcan’s plants. What is new, however, is the successive use of these various operations to process the SPL, making for a complete and continuous process.

In the LCLL process, the cyanides and fluorides contained in the SPL are separated from the solids by dissolution (leaching) using water, caustic soda and sulphuric acid, as needed. The recovered solids are mostly composed of carbon and inert materials. The solution containing the cyanides, fluorides and various sodium salts is processed in order to destroy the cyanides. The fluorides contained in the solution are extracted through evaporation and crystallization in the form of sodium fluoride. The resulting solution, after the evaporation step, is similar to the liquor from the Bayer process and can be reused to produce alumina.

The sodium fluoride recovered in this way can be purified and sold as is or even transformed into caustic soda and calcium fluoride.

4.4.1.3 *Technology Comparison*

Table 4.4.1 compares the main types of spent pot lining processing technologies and their characteristics with the technical and environmental criteria.

Table 4.4.1 Comparing Hydrometallurgic and Pyrometallurgic Processes

	Hydrometallurgical (eg, LCLL)	**Pyrometallurgical Processes (eg, Reynolds, CalSiFrit, Vortec, etc)**
Technical Criteria		
Technical feasibility	Combination of simple, known processes	Three units in operation in North America

	Hydrometallurgical (eg, LCLL)	**Pyrometallurgical Processes (eg, Reynolds, CalSiFrit, Vortec, etc)**
Tolerance of variations in spent pot lining composition	Leaching has considerable tolerance of variations in spent pot lining composition.	Process is sensitive to variations in spent pot lining composition.
Ability to destroy cyanides	Destruction of cyanides through hydrolysis	Destruction of cyanides through high-temperature degradation
Generated material	1.1 tonnes per tonne of processed spent pot lining	1.8 to 2.7 tonnes per tonne of processed spent pot lining
Types of generated material	Non-hazardous solid material with low Na content, which facilitates recycling in other industries	Solid material, nearly all of it sodium, which limits the potential for recycling in certain industries (ie, cement plants), whereas these residual materials sometimes keep the classification of "hazardous materials."
Compatibility of generated by-products	By-products can be used in the aluminum industry, particularly within Alcan.	By-products can only be used outside the aluminum industry.
Expertise	Technology is well-known at Alcan and Alcan has internal expertise.	The many, various Alcan research scientists who conducted an in-depth assessment of all of the pyrometallurgy-based processes did not find any benefits in them to give Alcan reason to increase its competencies in this area.
Environmental Criteria		
Atmospheric emissions	Particle emissions during spent pot lining handling and pulverizing stages. Ammonia waste associated with leaching and the destruction of cyanides.	Particle emissions during spent pot lining handling and pulverizing stages. Potential HF emissions requiring treatment of generated gases.
Technological risks	Risks associated with potential releases of ammonia from stored pulverized spent pot lining	Risks associated with potential releases of ammonia from stored pulverized spent pot lining
Liquid waste	Process does not generate liquid waste.	Process does not generate liquid waste.
Solid waste	Low quantities of solid waste to be buried in landfill (iron oxides and descaling residues). Carbons and inerts are stored temporily for upgrading.	The product generated in certain processes is buried in landfill.

4.5 Preferred Technology

4.5.1 Economic and Technical Issues

In order to address the problem of managing spent pot lining, Alcan International Limited has developed a process in Quebec known as LCLL (**L**ow **C**austic **L**eaching and **L**iming), which is a hydrometallurgical process based on several technologies that have already been tested at

Alcan and in other types of industries. This process offers the advantage of converting spent pot lining into products that could potentially be used as raw materials in various industries.

4.5.1.1 *Pilot Tests*

In 1994, acting on a recommendation made by a working committee, Alcan decided to develop the LCLL process. Following conclusive laboratory tests at the Arvida Research and Development Centre, the LCLL process for the conversion of spent pot lining was then the focus of two series of pilot tests conducted at COREM (formerly the Centre de recherche minérale). The first series was carried out in 1993 and the second between 1998 and 2000.

1993 Tests

The goals of the tests were as follows:

- To develop the LCLL process, through semi-industrial testing, for the processing of
- pot lining and the recycling of valuable products;
- To establish the feasibility of the concept and the stability of the process during ongoing use;
- To find (through testing) solutions or elements of solutions to help avoid the technical and economic pitfalls inherent to a new process;
- To collect experimental data to be used in gauging equipment and in the technical and economic evaluation of the process;
- To identify the products and meet targeted specifications;
- To gather operational data and chemical analyses of the process flow and determine the chemical balances of the flow and the water balance:
- To collect data to be used as design criteria for the filtration of leaching residues and sodium fluoride.

The tests revealed the stability of the process during ongoing use and provided the mass balance for both pot lining and water. Caustic leaching residues met the standards set out in the *Regulation respecting hazardous materials* for leachable fluorides in quantities of less than 150 mg/L. In fact, the tests show that the leachable fluorides range between 19 and 51 mg/L.

1998-2000 Tests

COREM conducted the second series of tests between December 1998 and May 2000. The main goal was to produce 10,000 litres of leachate for subsequent tests involving suppliers in order to choose the equipment to be used for the destruction of cyanides and crystallization.

Water and caustic leaching tests were carried out. Leachate from the two leaching processes was recycled by separating the solids from the liquids. Various types of separators for solids and liquids were tested, particularly a hydrocyclone, a table filter, a strap filter and a filter press.

These tests were also designed to measure the capacity of the LCLL process to treat pot lining from various sources. Following these tests, the activation washing step was added to the process in order to increase the fluoride recovery rate during the solid phase of the processing of pot lining from certain types of reduction cells.

4.5.1.2 *Advantages of the LCLL Process*

The LCLL process offers the following advantages:

- the capacity to support variations in spent pot lining composition;
- the destruction of cyanides;
- the production of a non-hazardous, low-sodium solid residue (carbon and inerts) that could be used in other industrial processes or, if necessary, safely buried;
- the potential to recycle and reuse fluorides as sodium fluoride;
- the production of a caustic soda and aluminate solution that can be reused in an alumina plant;
- the use of known procedures, techniques and equipment.

4.5.1.3 *Economic Feasibility*

The tests that have been conducted up until now have established the feasibility of building a plant with an annual capacity of 80,000 tons at an estimated cost of $232 million. The feasibility is based on the following factors:

- the various technologies required for processing spent pot lining have been tested;
- the annual amount of spent pot lining required per plant each year is available;
- the by-products of pot lining processing are non-hazardous and can safely be disposed of; they are also compatible with several other processes. The full utilization of the LCLL process generates the following by-products: Bayer liquor, carbon and inert materials, calcium fluoride (CaF2) and /or sodium fluoride (NaF), caustic, as well as aluminium;
- the unit cost of processing ($/t) will be lower than for other existing technologies or those being developed (Grolman, 1994);
- the operating costs are not likely to change significantly;
- the plant will be situated near the pot lining storage site and geographically located in the middle of Alcan's aluminium plant complex;
- the proximity of Alcan's Vaudreuil plant will enable the use of an industrial ecology approach, that is, the exchange of reagents and products that benefit both plants. Furthermore, since the pot lining treatment process is a hydrometallurgical process, we can benefit from the expertise of the Vaudreuil plant employees in this area.

All the components required to guarantee the technical viability and to minimize the operating costs of a spent pot lining processing plant in the Saguenay-Lac-Saint-Jean region are available here.

The annual capacity of the spent pot lining processing plant will be 80,000 tons of spent lining. The operation of the plant to its full capacity will be dependent on several factors, such as the optimization of the process, the composition of the pot lining to be processed and the market development for by-products generated by the processing.

Most of the spent pot lining supply for the new plant will come from existing Alcan operations and from stocks that are currently being stored in Jonquière. The remaining supply could come from other plants or companies.

4.5.2 Environmental and Socio-political Issues

The plant will be located near the Alcan aluminium plants in the Saguenay-Lac-Saint-Jean region and the regional county municipality of Le Fjord-du-Saguenay.

The project proponent, who was aware of public sensitivity in regards to environmental issues, held public consultations in June 1997 in order to present the project to residents and to gather comments from groups and individuals interested in the project. These consultations highlighted the following environmental issues inherent to this type of plant:

- atmospheric emissions;
- technological uncertainties;
- noise;
- solid waste;
- liquid waste;
- transportation;
- economic spinoffs.

The proposed project takes into consideration the concerns expressed by people in the area during consultations held in 1997 and 2001. Numerous changes were made to the original project that was introduced in 1997, particularly in terms of the site selection and the transportation strategy, in order to facilitate its integration into the community. Alcan believes that this project takes a sustainable approach to addressing the technical, economic, social and environmental issues it raises. The project ensures that Alcan assumes full responsibility for the processing of pot lining generated by its facilities.

5 SCOPE OF THE STUDY

This chapter describes the scope of the project as well as the factors considered for the environmental assessment of the project.

5.1 Scope of the Project

The scope of the project includes the construction, operation and decommissioning of a spent pot lining processing plant at Alcan's Jonquière facility in the Saguenay and, more specifically, the following work and activities:

- demolition of an existing building;
- construction of a spent pot lining processing plant;
- transportation of spent pot lining and the by-products produced by the LCLL process;
- operation of the spent pot lining processing plant;
- decommissioning of the spent pot lining processing plant;
- site rehabilitation.

5.2 Factors to be Considered

The environmental assessment includes consideration of the following factors listed in subparagraphs 16(1) (a) to e) and in paragraph 16(2) of the *Canadian Environmental Assessment Act*:

- the environmental effects of the project, including the environmental effects of accidents or malfunctions that may occur and any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out;
- the significance of the effects referred to in the previous point;
- comments from the public in this regard that are received during the environmental assessment;
- measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the project;
- the purpose of the project;
- alternative means of carrying out the project that are technically and economically feasible and the environmental effects of any such alternative means;
- the need for, and the requirements of, any follow-up program in respect to the project;
- the capacity of renewable resources likely to be significantly affected by the project to meet needs of the present and those of future generations;
- any other factor relevant to the comprehensive study, particularly the need for the project and alternatives to the project that the responsible authority or the Minister after consulting with the responsible authority, may require to be considered.

The environmental effects, as defined in paragraph 2(1) of the *Canadian Environmental Assessment Act*, are the changes the project may cause in the environment, particularly any change to a listed wildlife species, its critical habitat or the residences of individuals of that species, within the meaning of paragraph 2(1) of the *Species at Risk Act,* the effects of these changes on health and socio-economic conditions, the current use of land and resources for traditional purposes by Aboriginal persons, or any structure, site or thing that is of historical, archaeological, paleontological or architectural significance, and changes to the project that may be attributable to the environment.

5.3 Scope of the Factors to be Considered

The environmental assessment takes into account the potential effects of the project within the spatial and temporal boundaries that correspond to the periods and sectors in which the project could interact with or affect components of the environment.

The environmental assessment also takes into account, but is not limited to, the factors listed in Table 5.3.1

Table 5.3.1 Factors to be Considered

	Subject
Physical Environment	• hydrology and water quality (surface and groundwater); • geology, geomorphology and seismology; • meteorology, climatology and climate changes; • waste and by-product management; • upgrading of waste from the LLCL process, and the elements relating to the process and the plant's operations; • description of the technological uncertainties, particularly those relating to the upgrading of waste from the LLCL process, the proposed solutions and the alternatives to the project; • noise (including during construction and operation); • air quality (including odours, atmospheric emissions, dust and greenhouse gases).
Biophysical Environment	• habitat loss; • vegetation; • species at risk or of special status and their habitat; • fish and fish habitat; • wildlife and wildlife habitat, including migratory birds.
Human Environment	• worker health and safety; • public health (including the social determinants of health) and safety; • land and resource use (including recreational and tourism activities, and future development plans); • aesthetics and landscape; • local residents and site neighbours (including residential areas in the vicinity); • use of the land and resources for traditional purposes; • economic spinoffs; • heritage, cultural, historical, archaeological and paleontological resources.

5.3.1 Any Change to the Project Attributable to the Environment

The environmental hazards that may affect the project will have to be outlined and the anticipated effects of these environmental hazards will have to be documented. The following elements will have to be taken into consideration in the environmental assessment and the design of the project:

- seismic activity;
- climate changes.

5.3.2 Accidents or Malfunctions

The probability of malfunctions or accidents associated with the project during construction, operation, foreseeable modifications, decommissioning, abandonment, transportation of the spent pot lining and by-products, or other undertakings in relation to the project, including mitigation measures, and the potential adverse environmental effects of these events should also be identified and described. The description should include the following factors:

- accidental spills;
- accidental explosions;
- equipment malfunctions;
- emergency measures and plans.

5.3.3 Cumulative Environmental Effects

The cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out will have to be identified and assessed. The approach and methodologies used to identify and assess the environmental effects will have to be explained. The cumulative effects assessment should focus on, but not necessarily be limited to, the following elements:

- air emissions from the plant;
- waste water impact on the Saguenay River.

5.3.4 Renewable Resources

The environmental assessment will have to take into account renewable resources that could be significantly affected by the project and the criteria used to determine whether their sustainable use will be compromised. The proponent should discuss:

- upgrading of waste from the LLCL process;
- elements relating to the process and the plant’s operations.

5.3.5 Spatial and Temporal Boundaries

The construction of the demonstration plant should be completed during the first quarter of 2008. The completion of the demonstration phase is slated for the first quarter of 2009 and the completion of the commercial phase for the first quarter of 2011.

The area being studied runs north to south from the Saguenay River to the agricultural zone located to the south of Highway 70. From west to east, the area covers most the Arvida sector of Jonquière.

5.3.6 Proposed Design of the Follow-up Program

The purpose of the follow-up program is to verify the accuracy of the environmental assessment and determine the effectiveness of measures taken to mitigate the adverse environmental effects. The environmental assessment should include a discussion of the need for and the requirements of a follow-up program.

6 PUBLIC CONSULTATION

6.1 Introduction

Public consultations on the spent pot lining processing plant project in Jonquière have been held since 1997. Two approaches were adopted for these public consultations. The first was a corporate approach and was initiated by Alcan. The second was a governmental approach and stems from the implementation of the public consultation procedures set out in the *Environment Quality Ac*t and the *Canadian Environmental Assessment Act*.

6.2 Alcan Consultations

In 1997, Alcan undertook widespread consultations in the Saguenay-Lac-Saint-Jean region on a consortium project for a spent pot lining treatment plant in Jonquière; 18 meetings were held during this consultation process, and more than 318 people were involved. At the time, the site chosen for the plant was situated to the south of the Jonquière complex and to the north of Drake Street, therefore outside the Jonquière complex. Although the project did not take shape as planned, it did bring the citizens' concerns about this type of project to the forefront. Alcan initiated new communications measures in 2000 when the project was reintroduced.

6.2.1 Scope of the1997 Consultations

Eighteen meetings involving a total of 318 people were held between May 26 and July 3, 1997. The project proponents were well received by the groups they had asked to meet with. The various groups expressed interest in the project and in taking part in the consultation meetings. Their response to the proposed plant was generally favourable following each meeting, since they were reassured the project would go ahead given the proponent's credibility and the open communication with the public.

The groups who participated in the meetings were divided into six different segments of the population:

- municipal authorities (42 participants): Jonquière, Chicoutimi, La Baie and the MRC du Fjord;
- community groups (13 participants): CRÉ, Comité environnement La Baie, ZIP Saguenay and ZIP Alma Jonquière;
- citizens (43 participants): Ward 9 in Jonquière and the Chemin de la Réserve ward in Chicoutimi;
- Alcan employees and union representatives (118 participants): Vaudreuil, Arvida, Port Alfred port facilities, Laterrière, Isle Maligne, Grande Baie, SNEAA;
- "government" authorities (9 participants) : CSST and the regional health board;
- socio-economic stakeholders (93 participants): CRCD, Conférence des Chambres de commerce du Saguenay, CQRDA, Centre de Haute Technologie Jonquière Inc., Ordre des ingénieurs Saguenay/Lac Saint Jean.

During the course of the 18 meetings, participants asked 470 questions as the partners introduced the project, and many of these questions dealt with the same topics of interest. When the information was available, answers were provided immediately. If not, participants were told that they would be provided with further details when the impact study was presented.

Based on these 470 questions, the matters of interest and the concerns of the community were identified and grouped together under twelve different themes, that is:

- The process and the plant products (147 questions)
  - Transportation (52 questions);
- Current pot lining management carried out by partners (49 questions);
- Atmospheric emissions (46 questions)
  - Plant ownership and projected employment (41 questions);
- MEF approvals – community support and finances (32 questions)
  - Security at the new plant (31 questions);
- Capacity of the proposed plant (22 questions)
  - Size and location of the plant (19 questions);
- Other environmental concerns (16 questions)
  - Economic spinoffs (9 questions);
- Noise (6 questions).

Among all of the questions that were asked, many of them stemmed from the participants' eagerness to find out more about various aspects of the project, particularly with regards to the process and the plant products. In terms of the environment, the major concerns focused mainly on transportation, atmospheric emissions and noise.

6.2.2 Community Concerns Based on Analysis of the Questions

Here are the topics addressed by the participants for each of the twelve themes under which the questions were assembled:

THE PROCESS AND PLANT PRODUCTS (147 QUESTIONS):

- Source of industrial water and quality required
- Other technologies available worldwide and pollution
- Destruction of cyanides and autoclave capacity?
- Energy balance and energy supply (gas and dust)
- Level of iron and aluminium in the pot lining ....how should it be processed?
- Grinding and crushing: efficiency and duration of the process/week?
- Compatibility between "graphitized" cathodes and the LCLL process
- Hydrometallurgy kept separate from crushing?
- 300 mm parts upon arrival at the plant?
- Has the LCLL process been fully developed – pilot stage?

- Residues from each step
- Sources of sodium fluoride consumption
- Alcan's use of calcium fluoride
- Sources of carbon mixture consumption - bricks (also in LCLL)
- Purity levels of the products
- Alcan's use of Bayer liquor
- Products to replace other Alcan products (impact on transportation)
- Harmful components of pot lining?
- Sodium fluoride; is it dangerous?
- Processing costs - calcium fluoride?
- Use of fluoride residues from old potrooms in the LCLL process

TRANSPORTATION (52 QUESTIONS):

- Ratios: Truck - train - boat
- Highways used (Parc des Laurentides and regional highways)
- Number of trucks and trains each day
- Plant access (residential areas)
- Compensation for roadway use and maintenance
- Safe maritime transportation- containers or unsecured (see Pollux)
- Transportation of raw materials
- Product transportation from the plant
- Safe transportation by truck
- Responsibility for transportation?
- Container ownership and manufacturing?

CURRENT POT LINING MANAGEMENT (49 QUESTIONS):

- Volume of storage at Alcan in Jonquière
- Situation at other aluminium producers in Quebec
- Potential to recycle all stored pot lining? Time (6000 t/year)?
- Safety of the clay cells in Jonquière – to be processed first?
- Pot lining produced by old and new technologies
- Safety of current storage - gas
- Dry pot lining removal at the Arvida plant and a new certificate of authorization?
- Alcan – processing prior to1980 (start of storage)?
- Removal of pot lining from pots after 5 to 7 years...efforts to increase the length of time?
- Pot lining: transportation between the aluminium plants of other producers in Quebec and the United States?
- Variations in pot lining composition depending on the source

ATMOSPHERIC EMISSIONS (46 QUESTIONS):

- Processing – recycling of emissions and their magnitude
- Dust management inside the plant and in the air
- Prevailing winds
- Emissions falling in neighbouring areas and potential odours?
- Height of the stacks

- Toxic hazard of gases
- Gas and dust: compliance with government standards?
- Establish a “zero point” prior to construction?
- Ongoing monitoring of emissions
- Cancerous dust?

PLANT OWNERSHIP AND PROJECTED EMPLOYMENT (41 QUESTIONS):

- Types of jobs expected
- Unionization?
- Joint operation or Alcan only
- Proposed operating philosophy
- Size of Alcan’s share
- Processing costs to be assumed by each of the project partners
- Approval of the four partners required before proceeding?
- New company to be set up?
- Employee remuneration
- Royalties – Marketing the LCLL process?

MEF APPROVALS – COMMUNITY SUPPORT AND FINANCES (32 QUESTIONS):

- Possibility of public hearings?
- Groups met with during public consultations?
- MEF certificate of authorization...when?
- Why build now instead of continuing with storage?
- If residents object to the project...
- Reassuring neighbouring residents...how?
- Join forces with the CRCD (regional council for collaboration and development) for long-term action?
- Deadline for detailed engineering
- Will the project be in jeopardy if the costs are too high?
- Profitability of the project and product sales
- Chances the project will happen?
- Pollux legal remedies
- Project funding: government subsidies?
- Other technologies researched by Alcan

SECURITY AT THE NEW PLANT (31 QUESTIONS):

- Explosion risks
- Compatibility with the neighbouring fluoride plant (emissions)?
- Anti-explosive devices
- Distribution of EMP to citizens
- Gas and liquids: internal and external effects in the events of breakage
- Filtration of liquids: closed system? recycled filters?
- Tasks – work stations: worker safety
- Task ergonomics (operation and maintenance)
- Ongoing gas control and worker health
- Equipment and noise reduction for workers

- "Furring" activities
- Dust and worker presence

CAPACITY OF THE PROPOSED PLANT (22 QUESTIONS):

- Alcan's share and the additional available capacity
- Other partners' share
- Processing of pot lining from the new aluminium plant in Alma
- Processing of pot lining from other parts of the world?
- Possible increase in size and ownership?
- Possibility of "running out" of pot lining some day?
- Reynold's: prospective partner?
- Ratio of 3000 days/pots used to quantify potential pot lining
- Processing of pot lining from Kitimat... elsewhere?
- Processing of pot lining from Sebree (Kentucky, U.S.A.)?

SIZE AND LOCATION OF THE PLANT (19 QUESTIONS):

- Proposed sites in the area and the preferred location
- Possible expropriation?
- Distance from the nearest homes
- Decrease in property values?
- Use of land occupied by old pot rooms
- Expected surface area
- Link between the plant and the future (renovation) of the Jonquière complex?

OTHER ENVIRONMENTAL CONCERNS (16 QUESTIONS):

- Surface water
- Above-ground water reservoir near Hocquart Street
- Burial or storage of various products
- Possible steam emissions?
- Pot lining storage area: treated water as surface water?
- Bayer liquor pipeline ...above ground?
- Possible liquid waste?
- Tree planting around the plant?

ECONOMIC SPINOFFS (9 QUESTIONS):

- Subcontracting during construction
- Indirect employment following construction
- Trucking and jobs
- Detailed engineering and contracts in the region (cost splitting)
- Competition with the Alma project?

NOISE (6 QUESTIONS):

- Decibels in the vicinity of the plant
- Comparison to existing plants in Jonquière
- Possible effects of reverberation in residential areas

- Underground grinding?

6.2.3 Public Participation Approach and Communication Activities (2000-2001)

On December 19, 2000, Alcan issued a news release announcing that it was undertaking technical and environmental studies in order to find the best option for processing spent pot lining from its aluminium plants and to gradually reduce the amounts already in storage; the goal was to build a spent pot lining processing plant in Jonquière that would use the LCLL process.

Presentations outlining the project were promptly organized for groups of Alcan employees and their representatives, the City of Jonquière and environmental groups in the area (through the Conseil régional de l'environnement).

At the same time, the project team ensured that concerns raised during the 1997 consultation were included in the current impact study.

Given the public sensitivity with regards to the processing of hazardous residual materials, Alcan suggested to participants that consultations should be more in-depth than usual. The city of Jonquière supported this idea and proceeded to set up a work group in the community whose mission was to supervise the Alcan project and to ensure that the concerns of citizens were taken into consideration.

The first participants were the city of Jonquière, the Société de Développement de Jonquière, ZIP Alma Jonquière, the Conseil régional de l'environnement, the Syndicat national des employés d'Alcan d'Arvida, the Comité d'environnement de Chicoutimi, the Chambre de commerce de Jonquière, the Centre local de développement Jonquière and Alcan. Representatives of the public health department and the Ministère de l'environnement were also in attendance as non-participatory observers.

Participants agreed that it was important that citizens living near the Jonquière complex be included in the group of participants. The city of Jonquière then sent 1200 invitations to residents in the affected area and five citizens are now members of the work group.

A schedule was drawn up for the working meetings.

As the proponent and expert, Alcan played an active role in the work group's activities and provided the members with all the support they needed.

On May 31, 2001, Alcan issued another news release announcing that effective October 1, 2001, the company would have to ship the spent pot lining from its aluminium plant facilities in Quebec to the processing plant in Gum Springs, Arkansas (U.S.A.). Alcan promised to disclose all the transportation details to affected residents before the start of operations.

An article published in the June 22, 2001 edition of *Le Lingot* provided a detailed account of how the transportation of spent pot lining to Gum Springs was managed internally and how emphasis was placed on health, safety and environmental protection.

In July 2001, Alcan launched an Internet site devoted to the project. In addition to finding extensive information on the project, the product and the technology, users can ask questions, write comments or access related sites using the links provided. The site (available only in French) is found at the following address: www.brasque.alcan.com.

In September 2001, a newsletter reiterating the highlights of the project and Alcan's response to concerns expressed by citizens was distributed to all affected or interested members of the community.

In October 2001, an information and discussion session on the fundamentals of the impact study was held for affected and interested citizens and groups.

Moreover, Alcan welcomes all information requests from the public and assures that every effort will be made to meet with members of the public.

6.3 Government Consultations

Quebec Government

On October 28, 2003, Quebec's Environment Minister released the documents relating to the environmental impact study on the spent pot lining processing plant project in Jonquière. It should be noted that this impact study had been prepared at the Minister's request, in accordance with the environmental impact assessment and review procedure outlined in section 31.1 of the *Environment Quality Act*. The documents were available for public consultation until December 12, 2003. During this 45-day period, the public was able to find out about the project and, if they wished, submit a request to the Minister for a public hearing. The Minister received five requests. As a result, he instructed the Bureau d'audiences publiques sur l'environnement (BAPE) to hold hearings on the project. These hearings began on January 19, 2004 and the commissioners submitted their report to the Minister on April 22, 2004.

During the first segment of these hearings on January 19-20, 2004, the public was able to ask all the questions they felt were pertinent to the project. The public also had the opportunity to present written submissions to the commission, particularly during a session held by the BAPE on February 17, 2004.

All of the documents reviewed during these hearings, including the written submissions from the public, are available (in French) on the BAPE site (http://www.bape.gouv.qc.ca).

The concerns of participants at the BAPE hearings (office of public hearings on the environment) pertain to the following topics:

- Provenance of spent pot lining, particularly spent pot lining from outside the Region;
- Concentration of hazardous waste in the Region due to the presence of other hazardous waste treatment plants in the Region;
- Projected plant's capacity in relation to the production of spent pot lining specific to Alcan;
- Treatment process from the perspective of its validation by an independent authority;
- Finding uses for treatment by-products by promoting their upgrading;

- Environmental impacts of the project, including concerns about air quality and its effects on health and quantity of water drawn from the Chicoutimi River;
- Economic spinoffs with positive effects on job creation and local businesses.

Federal Government

On April 6, 2005, Industry Canada (through Technology Partnerships Canada) published a notice of commencement in the Canadian Environmental Assessment Registry (Reference Number 05-03-991) regarding a comprehensive study in accordance with the *Canadian Environmental Assessment Act*. One month later, Technology Partnerships Canada invited the public to consult and comment on a document outlining the scope of the comprehensive study. A revised version of the scoping document was published on July 22, 2005 and included changes made based on public comments.

Comments from the public at this stage concern the following topics:

- Method of storing by-products and quantity of residues produced;
- Assessment of the risks of defective equipment;
- Assessment of the impacts on air quality and health;
- Transportation of spent pot lining and plant supply scenarios;
- Environmental monitoring;
- Comparison of available technologies;
- Quantities of water diverted from the area;
- Plant treatment capacity;
- Sustainable development perspectives related to the project.

On September 14, 2005, the Minister of the Environment confirmed that the in-depth study was the most appropriate environmental assessment method for the project. The revised document on the scope of the in-depth study was made public on September 27, 2005.

All available documents can be found on the Canadian Environmental Assessment Agency Web site at the following address: http://www.acee.gc.ca/050/index_e.cfm.

7 DESCRIPTION OF THE RECEIVING ENVIRONMENT

7.1 Site Pre-selection and Selection

The Jonquière region is a favourable choice for the site of the proposed processing plant given the fact that the following facilities are located there: the facility used to store Alcan's spent pot lining stock, the pot lining removal centre that services the Arvida, Shawinigan and Beauharnois plants, and several chemical plants that generate products such as various types of aluminium and aluminium fluoride. Finally, Jonquière is close to two other Alcan pot lining removal centres in operation at the Grande-Baie and Alma plants.

In 1995, the consortium of firms that included Alcan had chosen a site located immediately to the west of the south entrance to the Jonquière complex as an alternative to the preferred sites located a bit further east. The land in question was situated between Drake Street and the railway right-of-way that runs beside the Alcan facilities. The site was located in an industrial area but outside the limits of the Jonquière complex.

When Alcan took over the project as a single proponent, it was clear that additional technical, economic and environmental advantages could be gained by integrating the processing plant within the limits of its industrial facilities in the Jonquière complex. This would also address concerns raised by some citizens who wanted the new plant to be located as far away as possible from residential areas.

The site chosen by Alcan is the current location of Building 311 (refer to the drawing of the Jonquière complex in Appendix A). The building is a bauxite warehouse that is no longer used and will be demolished to make way for the processing plant.

The selected site stands out for the following reasons:

- its integration within the Jonquière complex ensures that linking to existing service infrastructures will be both easy and inexpensive;
- this integration will also allow for the adoption of an industrial ecology approach, that is, the exchange of reagents and products with other parts of the industrial complex;
- the site acquisition cost is nil;
- transportation costs related to the operation of the plant are low;
- the site is located in an industrial area and is therefore consistent with the use of surrounding land;
- the site will be barely noticeable since it is located in a highly industrial area;
- it minimizes the transportation requirements in urban areas;
- it allows for the use of existing infrastructures (offices, warehouses, showers, etc.).

Furthermore, the Drake Street site is located 300 m from the nearest home while Building 311 is situated 900 m from the nearest home, which reduces the risks of inconveniences for area residents.

7.2 Delineation of the Study Area

The study area extends north to south from the Saguenay River to the agricultural zone south of Highway 70. From west to east, it covers the largest part of the Arvida sector of Jonquière. Centred around Alcan's Jonquière complex, the study area allows for the integration of the nearby territory that will possibly be affected by the project (i.e. the existing aluminium plant and chemical plants) and the surrounding urban and peri-urban areas that situate the overall project in terms the use of space, the flora and fauna and the structure of the transportation networks. In the case of more specific aspects such as emission dispersion and transportation issues, the study area is broadened as required.

7.3 Biophysical Environment Components

7.3.1 Physical Environment Components

The Alcan aluminium plant site where the pot lining processing plant is to be built is located within the Upper Saguenay lowlands, characterized by a subhorizontal topography and the prevalence of clay deposits. The vegetation is closely linked to the development criteria for the area, which is predominantly agricultural and urban.

7.3.1.1 *Land Topography*

The topography of the study area is fairly uniform with a slight slope of 0.5% to 1% to the north (toward the Saguenay River) and an elevation that varies between 140 metres in the southern part of the study area to approximately 110 metres in the northern part. However, the banks of the waterways are steeper. Rocky outcrop sections are also found in some parts of the study area, and their elevation can reach more than 160 metres. The "red clay lake" area, which is located to the south of the Jonquière complex, reaches elevations of more than 140 metres. The proposed site where the storage cell for inert waste is to be built is also fairly flat, with an elevation of about 110 metres.

The generally subhorizontal topography is modulated, on the one hand due to the presence of rocky outcrops and on the other hand because of hydrology-dependent ravines.

More extensive rock zones can be found along the edge of the Saguenay River. Further inland to the south, clay is visible in some areas, particularly to the southwest of the aluminium plant, forming what appear to be Kenogami horst relicts.

7.3.1.2 *Regional Geology*

The existing rock geology was mapped by Laurin and Sharma (1975) and modified by Lasalle and Tremblay (1978). Most of the rocks in the region are Precambrian and are part of the Grenville series. They can be divided into three main categories: distinctly sedimentary rocks and gneissic rocks, pyroxine plutonic rocks and granitic rocks.

Throughout the study area, the rocky mountain mass is part of a gneiss complex made up of homogenous grey gneiss containing quartz, feldspar, biotite and/or hornblende, with layers rich in hornblende and/or biotite and amphibolites. The existing rock is generally solid and slightly cracked.

The geology of the superficial deposits is based on the work of Lasalle (1973) and Lasalle and Tremblay (1978). The nature of the area's superficial deposits is linked to the ice cap that covered the region. The oldest deposit in the region is a till that sits on the existing rock. There are also fluvioglacial deposits made up mostly of sand, as well as marine deposits from the Laflamme Sea that appeared to develop as soon as the region was free of ice. These deposits include silty clay and clayey silt that have settled on the till or fluvioglacial deposits and shallow water deposits made up of sand and gravel.

The study area features a layer of silt and clay from the Laflamme Sea, except in a few places where the rock crops out and a basal till and ablation moraine are found.

7.3.1.3 *Seismicity*

Jonquière is located in a seismic activity area as was apparent during the earthquake that hit the region on November 25, 1988, registering a magnitude of 6.5 on the Richter scale. The seismic zoning map in the National Building Code (NBC) shows that Jonquière is classified as a 4 for peak horizontal ground acceleration (Za between 0.16 and 0.23 g) and as a 3 for horizontal ground speed (Zs between .11 and 0.16 m/s). The probability of recurrence used in the NBC is 0.0021 per year. This corresponds to a 10% probability that an earthquake will cause ground movement that is greater than what is specified in the NBC for a 50-year period.

Building design takes into consideration earthquake loading as required by the NBC. In the case of the temporary storage cell for inert waste, stability analyses that were carried out to determine the geometry of the grade also took into account NBC seismic data.

7.3.1.4 *Surface Materials*

Surface materials mirror the dynamics that influenced the formation of the regional landscape, particularly the flooding that followed the last glaciation. The area being studied is therefore mainly covered with marine clay sediment, broken up here and there by rocky outcrops. Sunken areas contributed to the formation of organic deposits, as is the case in the southern part of the study area where two peat bogs can be found.

The clay soils display distinct characteristics depending on whether they are found in hilly areas (Larouche and Taillon series) that are more susceptible to erosion, on well-drained subhorizontal lands (Chicoutimi and Alma series) or on sunken surfaces (Hébertville and Taché series) where drainage is poor.

The site chosen for the new plant is situated inside the aluminum plant's industrial area where the soil has already been reworked in various ways, while the storage areas are located on well-drained clay soil with a subhorizontal topography.

7.3.1.5 *Hydrography*

The regional drainage network is shaped by the Saguenay River. The Jean-Deschêne Brook runs through the heart of the study area. To the east, drainage is channelled toward the Chicoutimi River, located a short distance from the area. The drainage network in the plant area is directly linked to the Saguenay River, while the storage site drainage network is dependent on the Chicoutimi River drainage basin.

The drainage of surface water from the Jonquière complex is carried out through the sewer system. Two water channels are found to the east of the plant – the Chicoutimi River and the Lahoud Brook – and both flow toward the Saguenay. The Chicoutimi River is one of the outfalls of Lake Kénogami (located approximately 10 km to the south) and drains the surface water from the eastern part of the study area. Alcan has a pumping station in that area (Pont Arnaud) that supplies raw water to its plants. The Lahoud Brook takes in water from a multitude of brooks and pools and provides surface drainage for the red clay site area and the pot lining burial and storage area. The Jean-Dechêne Brook is located approximately 2 km to the west of the pot lining processing plant. Drainage for the residential sectors in the study area is provided by a storm sewer system.

The map of areas susceptible to ground movement prepared by Dion (1986) shows only one area that poses a low to medium risk of ground movement, which is located at the eastern tip of the study area along the banks of the Chicoutimi River. Furthermore, it should be noted that the floods that swept the region in 1996 could have affected the validity of this map in the area along the banks of the Chicoutimi River. However, the pot lining processing plant and the inert waste storage site are not located in an area that is susceptible to ground movement.

Due to these floods, the only map currently available is a temporary map of flood hazards based on the areas that were flooded in 1996 (Katia Tremblay, Hydric Information and Appraisal Service, Ministère de l'environnement, 2001, personal communication). However, the pot lining processing plant and the inert waste storage site are located outside the area flooded by the Chicoutimi River in 1996.

7.3.1.6 *Hydrogeology*

At the proposed site for the pot lining processing plant and storage cells, it is likely that the run-off of groundwater is widely affected by the presence of existing underground infrastructures (sewer system, gas lines, compressed air lines, etc.). In the northeastern part of the proposed site for the storage of inert waste, groundwater would run off to the north towards the Saguenay[8]. The groundwater would be found between 2.5 m and 3.5 m below the ground surface.

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8 Techmat Inc., Geo-technical Follow-up Study – Gudgeon Maintenance Centre, File no. J-83305, March 1983.

7.3.1.7 *Groundwater Quality*

A groundwater sample was collected exactly at the site of the pot lining processing plant in June 2005[9] in a sounding done directly to the west of the plant. The analytical findings show that the groundwater contains fluoride (14 mg/l) that exceed the criteria for seepage into sewers (4 mg/l) set out in the *Soil Protection and Rehabilitation of Contaminated Sites Policy* established by Quebec's Ministère du Développement durable, de l'Environnement et des Parcs (MDDEP). If water must be pumped during operations, it will be moved to the red clay disposal site based on the fluoride level. It should also be noted that an identification process for industrial site groundwater will be included in the clean-up certificates that the MDDEP is preparing in collaboration with the aluminium industry.

As for the storage site, the groundwater quality will be checked when the site preparation work begins. This analysis will determine the initial site conditions just before storage activities begin.

7.3.1.8 *Industrial Waste Removal Locations*

The GERLED inventory of industrial waste removal sites lists four sites within the study area. They are: the red clay disposal site, located approximately 1 km southeast of the Vaudreuil plant; the Elkem Métal dump at 2020, chemin de la Réserve in Chicoutimi; Gagnon Suzuki Automobile at 1411, chemin de la Réserve in Chicoutimi; and Les Pétroles R.L. inc. at 2281 Du Royaume Bouleveard in Jonquière. The last three sites are located in the southern part of the study area. Other sites on Alcan property were completely restored and have been downgraded (former pot lining storage sites, Drake Street, pot lining burial cell and the solid waste disposal site) or are in the process of being downgraded (gypsum pile).

Two industrial waste disposal sites are currently in operation for the Jonquière complex: the industrial waste disposal site (referred to as the SDDI) and the red clay disposal site. Waste (other than carbon and inerts) generated by the pot lining processing plant will be disposed of at the red clay disposal site. This site receives between 800,000 and 900,000 tons of dry waste each year. The leachate recovered from the red clay disposal site is recycled for the Bayer process used in aluminium production.

7.3.2 Atmosphere

There is only one measurement station in the Jonquière region near the project site that is part of the Air Quality Monitoring Program run by Quebec's Ministère du Développement durable, de l'Environnement et des Parcs (MDDEP). The location of this station is shown in Figure 7.3.1. The total ambient airborne particulates were measured at this station up until 2002. Airborne particulates smaller than 10 µm (PM10) and sodium dioxide concentration (SO_2) are measured here. The station's features are noted in Table 7.3.1

9 Techmat inc. Supplementary Environmental Characterization – Program in early June 2005 – Pot lining processing plant (PLPP) – File no. 1050419, June 2005.

Table 7.3.1 Features of the Air Quality Measurement Station in Jonquière

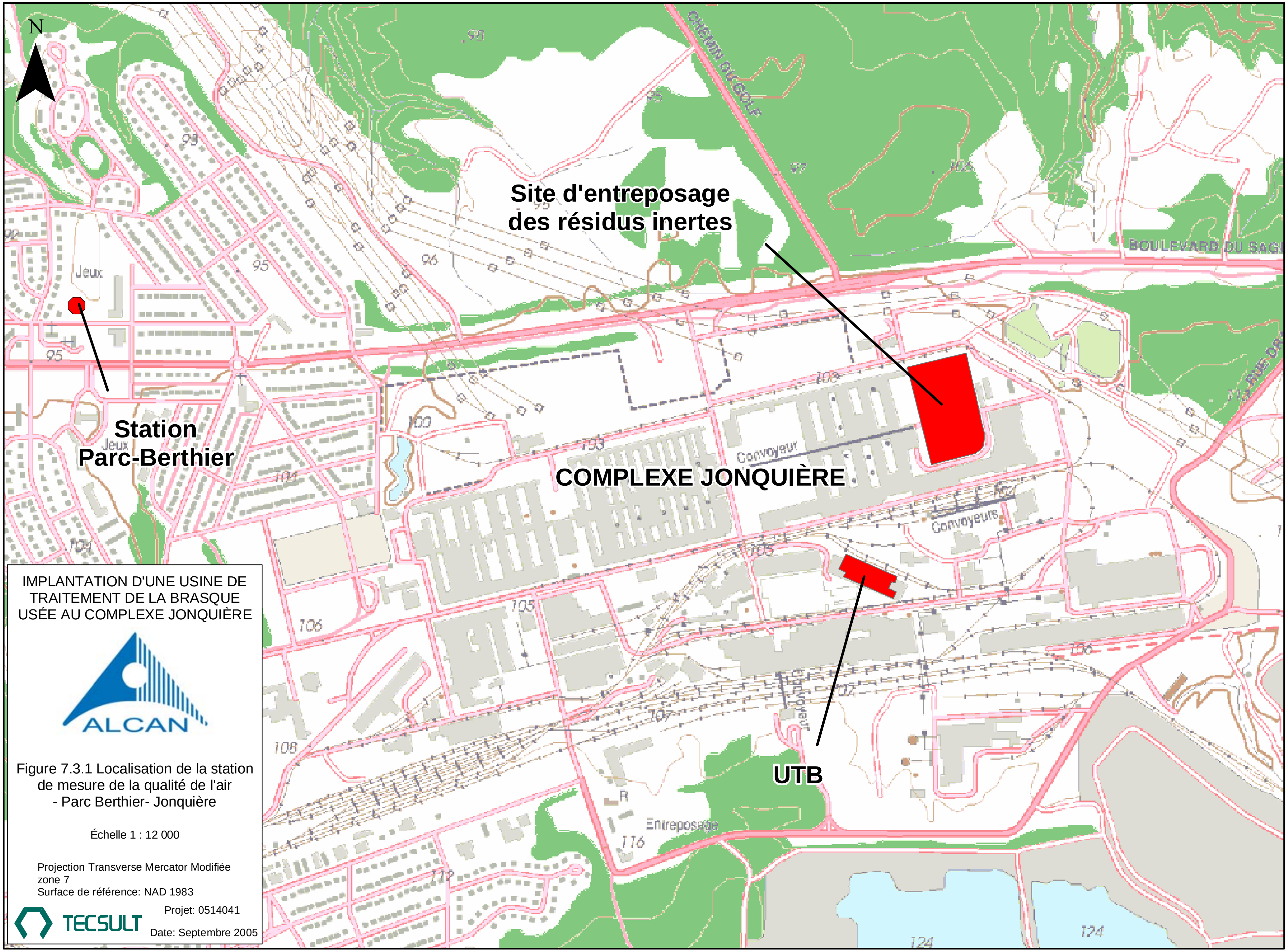
STATION NUMBER	STATION NAME	LOCATION	CONTAMINANTS MEASURED
02016	Parc Berthier	Berthier Street, Jonquière	Total airborne particulates (until 2002)
			Airborne particulates smaller than 10 µm (PM10)
			Sulphur dioxide

Table 7.3.2 shows the average and maximum values of the concentration of total airborne particulates detected at the Parc Berthier station in Jonquière since 1996. This data shows that at the Parc Berthier Station (02016), the daily standard for airborne particulates (150 µg/m^3) was exceeded once a year in 1996 and 1998. The annual standard of 70 µg/m^3 was never exceeded between 1996 and 2002.

Table 7.3.2 Concentration of Ambient Airborne Particulates Measured at the Parc Berthier Station (02016)

YEAR	QUANTITY OF DATA	DAILY MAXIMUM (µg/m^3)	ANNUAL AVERAGE (geometric) (µg/m^3)	NUMBER OF TIMES THE DAILY STANDARD WAS EXCEEDED (%)[1]
1996	58	198	36.3	1 (1.7%)
1997	59	137	29.8	0 (0%)
1998	58	161	32.7	1 (1.7%)
1999	58	142	38.0	0 (0%)
2000	61	150	29.6	0 (0%)
2001	58	105	29	0 (0%)
2002	5	56	23	0 (0%)

[1]The quality standards for ambient airborne particulates are 150 µg/m^3 for the 24-hour average and 70 µg/m^3 for the annual geometric average.



IMPLANTATION D'UNE USINE DE TRAITEMENT DE LA BRASQUE USÉE AU COMPLEXE JONQUIÈRE

ALCAN

Figure 7.3.1 Localisation de la station de mesure de la qualité de l'air - Parc Berthier- Jonquière

Échelle 1 : 12 000

Projection Transverse Mercator Modifiée
zone 7
Surface de référence: NAD 1983

Projet: 0514041

TECSULT

Date: Septembre 2005

0507953Figure 7.3.1 (07-05) AG 9.0 SB

7.3.1 Correspondence Table

Site d'entreposage des résidus inertes	Inert waste storage site
Station Parc-Berthier	Parc Berthier Station
Complexe Jonquière	Jonquière complex
UTB	PLPP
Implantation d'une usine de traitement de la brasque usée au Complexe Jonquière	Implementation of a spent pot lining processing plant at the Jonquière complex
Figure 7.3.1 Localisation de la station de mesure de la qualité de l'air – Parc Berthier - Jonquière	Figure 7.3.2 Location of the Parc Berthier air quality measurement station in Jonquière
Échelle 1 : 12 000	Scale 1: 12,000
Projection Transverse Mercator Modifiée zone 7	Modified transverse Mercator projection, Zone 7
Surface de référence : NAD 1983	Reference area: NAD 1983
Projet : 0514041	Project: 0514041
Date : Septembre 2005	Date: September 2005

Table 7.3.3 shows the concentration of airborne particulates smaller than 10 μm (PM10) measured at the Jonquière station between 1996 and 2003.

The *Regulation respecting the quality of the atmosphere* that is currently in effect does not impose a standard for particulates of less than 10 μm.

Table 7.3.3 Concentration of Ambient Airborne Particulates Smaller Than 10 µm (PM 10) Measured at the Parc Berthier Station (02016)

YEAR	QUANTITY OF DATA	ANNUAL AVERAGE ($\mu g/m^3$)	98th PERCENTILE	DAILY MAXIMUM ($\mu g/m^3$)
1996	59	25.5	103	138
1997	61	18.6	77	104
1998	59	20.4	91	96
1999	58	24.4	91	94
2000	61	15.7	74	95
2001	59	15	51	68
2002	55	15	69	89
2003	41	18	71	75

Table 7.3.4 shows the concentration of sulphur dioxide measured at the Jonquière station between 1996 and 2000. The daily ambient air quality standard for SO_2 was exceeded twice in 1998. The hourly and annual standards were not exceeded throughout the 1996-2000 period.

Table 7.3.4 Concentration of Sulphur Dioxide Measured in Ambient Air at the Parc Berthier Station (02016)

YEAR	YEARLY AVERAGE (PPB)	DAILY MAXIMUM DETECTED (PPB)	HOURLY MAXIMUM DETECTED (PPB)	NUMBER OF TIMES THE DAILY MAXIMUM WAS EXCEEDED (%) [1]
1996	12.5	97	182	0 (0 %)
1997	10.8	109	169	0 (0 %)
1998	12.9	111	198	2 (0.02 %)
1999	10.2	94	206	0 (0 %)
2000	9.4	75	183	0 (0 %)
2001	11.8	111	242	2 (0.02 %)
2002	11.6	120	199	7 (0.08 %)

1 The ambient air quality standards for SO_2 are 20 ppb for the annual average, 110 ppb for the 24-hour average and 500 ppb for the hourly average.

7.3.3 Regional Climate

The climate can be described using the following three main parameters: wind, temperature and precipitation. In Canada, wind speed and direction as well as temperature are monitored daily at Environment Canada weather stations. The amount of precipitation is monitored once or twice each day.

7.3.3.1 *Choice of Weather Station*

There is a weather station on the Alcan property in Jonquière, near the future spent pot lining processing plant. The Arvida weather station used to be located behind the Jonquière weather office and was then moved onto the Alcan property. The data available from this station (starting from 1994) is the most representative of the prevailing climate in this area. The wind and temperature data are taken from this station, while the precipitation data recorded at the Arvida station (in operation between 1931 and 1989) is used.

7.3.3.2 *Winds*

According to Environment Canada, wind speed is defined as the air speed at a given point, expressed in km/h. Wind direction is the direction from which the wind is blowing. Speed and direction data, which are used to calculate monthly and annual average values, cover the period between 1996 and 2000.

Figure 7.3.2 shows the average wind frequency for each of the 16 directions on the wind rose. Figure 7.3.3 shows the average wind speed for the 16 directions.

Appendix E-6 contains the figures showing the wind rose for each year from 1996 to 2000 inclusively.

The prevailing winds in the Jonquière region develop mostly in the area from the west/north/west to west/south/west, following the direction of the Saguenay River. The wind frequency for the east/south/east and east directions is also fairly high.

The average wind speed is at its maximum for the west/north/west (19.6 km/h). The average speeds for the north/west and west directions are 17.2 km/h and 16.9 km/h respectively.

7.3.3.3 *Temperature*

Figure 7.3.4 illustrates the trend for the minimum, maximum and average monthly temperatures recorded at the station on the Alcan property between 1996 and 200 inclusively. The minimum or maximum average monthly temperature represents the average of all the minimum or maximum daily temperatures recorded throughout the month.