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Clark Island Site

Grande-Ile Shoreline Sediments Characterization

May 1993



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May 1993



**Tecsult Inc.**  
consultants

85 ST. CATHERINE STREET WEST, MONTREAL, QUEBEC CANADA



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## **1.0        OBJECTIVES**

The objectives of the Grande-Ile Shoreline Sediments Characterization are of diverse nature. First of all, the information obtained is used to increase the actual sediment database in Priority Zone II in order to develop a better understanding of the level of heavy metals concentrations along Grande-Ile Shoreline. Based on this additional data the areal extent of the zone of the heavy metals concentration will be determined and a better knowledge of the geotechnical characteristics of the sediments will be obtained. The areal extent is defined using Iterim Sediment Criteria defined by the Quebec Ministry of the Environment (MENVIQ) in April 1992. The additional data will also provide a more detailed bathymetry of the studied area.

A second objective of the Grande-Ile Shoreline Sediments Characterization is to provide additional data that will be useful in the AlliedSignal decision making process. The data will be used to update the health risk analysis and to estimate the volumes of contaminated sediments.

Another objective of this characterization is to provide additional data that will be utilized in the event further sampling works are required for the determination of sediments toxicity. If such tests are required, the sediment geotechnical characteristics and the Total Organic Carbon content in sediments are necessary parameters to help selecting sampling stations.

## **2.0        SCOPE**

The Priority Zone II sediments area has been defined as the area along Grande-Ile shoreline between Clark Island causeway and Hydro-Québec dams where the water depth is shallow (<1.5 m). This value of 1.5 meters has been chosen as the maximal water depth where people could conceivably come

in contact with sediments while wading in the river water and floundering in the sediments.

During the Phase III sediments characterization works carried out in 1990, a total of eleven (11) surface samples were collected along the Priority Zone II area. Out of these samples, eight (8) were found to be contaminated by heavy metals.

As part of the present sediment characterization along Grande-Ile shoreline, field work was carried out in February and March 1993 in order to better define the geotechnical and chemical characteristics of the sediments. The work included the collection of seventy-three (73) surface samples out of which sixty-eight (68) were located along Priority Zone II area and five (5) along the North-West shoreline of Clark Island (Priority Zone I), as shown in Figure 2.1 (see Appendix C). All field work was carried out from the surface of the ice cover. A detailed geotechnical and chemical testing program was implemented for all collected samples.

### **3.0            MENVIQ GUIDELINES**

In April 1992, Environment Canada, the St-Lawrence Centre and MENVIQ published interim criteria on the St-Lawrence river sediment quality.

In the Tecsult Phase III sediments characterization, the evaluation of the sediment contamination was based on the Ontario's guidelines since the Province of Quebec did not have at that time specific sediments criteria. The new Quebec guidelines, published in 1992, are more stringent than the Ontario's guidelines, previously utilized. Following the publication of these criteria, the lateral extent of the contamination around Clark Island was reviewed in August 1992.

Three concentration levels are defined in the new MENVIQ guidelines. Level 1 represents the no effect level (background level) where there is no acute or chronic effect on benthic organisms. Level 2 represents the minimal effect level where effects are observed but are considered tolerable for the majority of benthic organisms. Level 3 represents the harmful effect level where effects for the majority of benthic organisms are observed. Level 3 also corresponds to the level where restoration works must be envisaged. Table 3.1 shows the three level criteria used by MENVIQ to classify contaminated sediment sites.

#### **4.0            BACKGROUND STATIONS**

Since 1988, three (3) stations were used upstream of Clark Island to define background sediment quality. River bottom sediments were collected at these stations, and were analyzed for the main heavy metals of concern. Three (3) samples were collected in 1988 at the Grosse-Pointe Island. In 1990, three (3) samples were collected near Coteau-Landing area, and five (5) samples were taken around Longueuil & Giroux islands. These stations are illustrated in Figure 4.1. Also, Serodes has defined in 1978 the median value of some heavy metals for downstream half of St-François lake.

Table 4.1 compiles all background values and MENVIQ level 3 criteria. According to this table, it can be noted that background values are generally below MENVIQ level 3 criteria.

**TABLE 3.1**  
**ALLIED SIGNAL INC. – CLARK ISLAND SITE**  
**GRANDE-ÎLE SORELINE SEDIMENTS CHARACTERIZATION**  
**MENVIQ GUIDELINES**

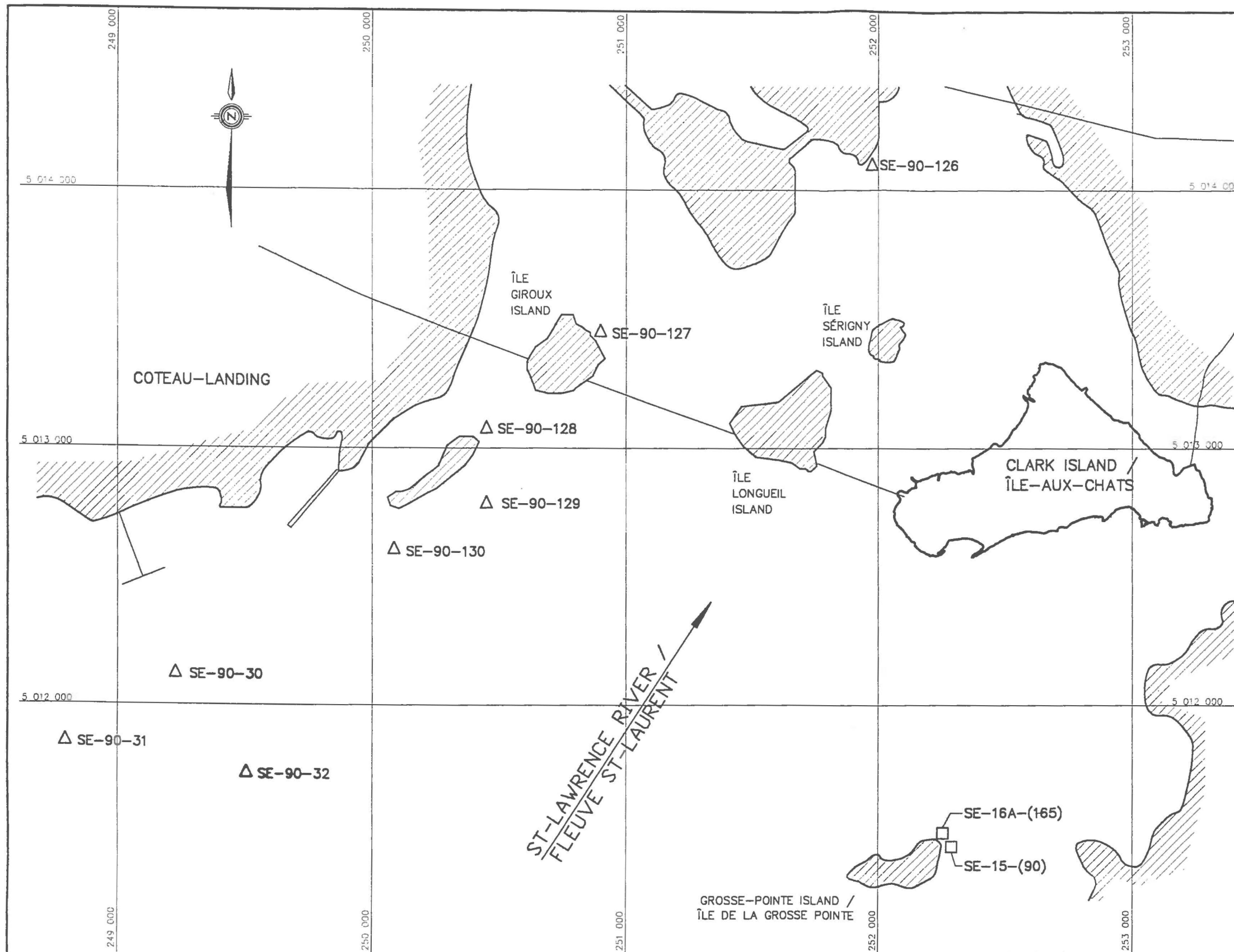
PARAMETER	LEVEL 1 (mg/kg)	LEVEL 2 (mg/kg)	LEVEL 3 (mg/kg)
ARSENIC	3.0	7.0	17.0
CADMIUM	0.2	0.9	3.0
CHROMIUM	55.0	55.0	100.0
COPPER	28.0	28.0	86.0
MERCURY	0.05	0.2	1.0
NICKEL	35.0	35.0	61.0
LEAD	23.0	42.0	170.0
ZINC	100.0	150.0	540.0

NOTE: LEVEL 1 – NO EFFECT LEVEL : BACKGROUND LEVEL, WITHOUT ACUTE OR CHRONIC EFFECT ON BENTHIC ORGANISMS

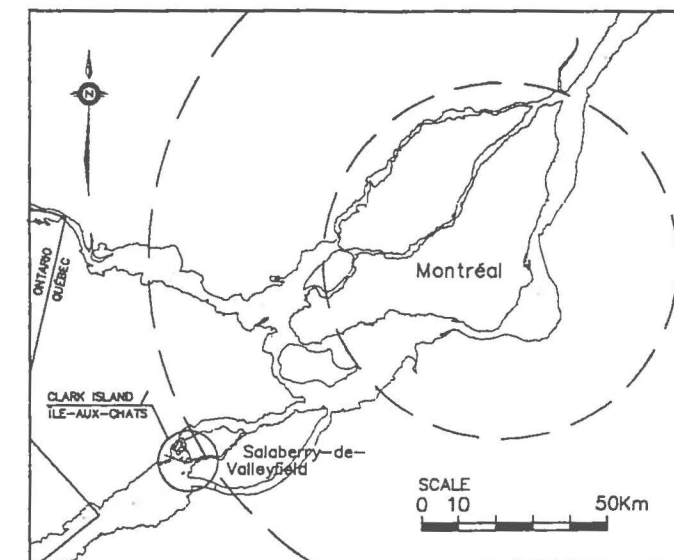
LEVEL 2 – MINIMAL EFFECT LEVEL : LEVEL WHERE EFFECTS ARE OBSERVED BUT ARE CONSIDERED TOLERABLE FOR THE MAJORITY OF BENTHIC ORGANISMS

LEVEL 3 – HARMFUL EFFECT LEVEL : LEVEL WHERE EFFECTS FOR THE MAJORITY OF BENTHIC ORGANISMS ARE OBSERVED





KEY PLAN



- SE-16A(165) ☐ SURFACE SEDIMENTS SAMPLING STATION/  
STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS  
DE SURFACE (JANUARY/JANVIER 1988)
- SE-90-126  SURFACE SEDIMENTS SAMPLING STATION/  
STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS  
DE SURFACE (JUNE/JUIN 1990)

			BACKGROUND SAMPLING STATIONS	
N° contrat/contract	Échelle / Scale	Date	FIGURE : 4.1	
4361-1000	indicated	APRIL 1993		

**TABLE 4.1**  
**ALLIED-SIGNAL INC. - CLARK ISLAND SITE**  
**GRANDE-ILE SHORELINE SEDIMENTS CHARACTERIZATION**  
**BACKGROUND STATIONS CONCENTRATIONS (1)**

SAMPLING DATE	OCT.87-JAN.88	FEBRUARY 90	JUNE 90	SERODES 78	MENVIG LEVEL 3 CRITERIA
LOCATION	GROSSE POINTE ISLAND	COTEAU-LANDING	LONGUEUIL & GIROUX ISLANDS	LAKE ST-FRANCOIS	ST-LAWRENCE RIVER
NUMBER OF SAMPLES	2	3	5	-	-
ARSENIC	0.17-0.25	4.7-5.0	0.5-5.4	3.3	17.0
CADMIUM	<1.0-1.3	<1.0	0.7-4.3	-	3.0
COPPER	9.3-12.0	42.0-45.0	8.0-59.0	37.0	86.0
MERCURY	0.26-0.52	1.30-1.94	0.15-1.17	0.22	1.0
LEAD	7.5-8.2	56.0-60.0	6.1-47.7	18.0	170.0
SELENIUM	0.14-0.25	15.3-19.4	0.2-1.1	-	-
ZINC	81.0-87.0	35.0-279.0	49.0-384.0	105.0	540.0

NOTE: (1) ALL CONCENTRATIONS ARE IN mg/kg

## 5.0

### OVERVIEW OF THE UPDATED PHASE III DATA

During Phase III characterization work, the eleven (11) river bottom samples collected in February and June 1990 along Grande-Ile shoreline were submitted to an analytical program. The location of the sampling points is shown on Figure 2.1 together with the location of the 1993 sampling points.

Samples were analyzed in the laboratory Technitrol-Eco from Pointe-Claire for the main heavy metals (As, Cd, Cr, Cu, Fe, Hg, Ni, Pb, Se, Zn). In August 1992, sediment concentrations found in Priority Zone II area were compared with the new Quebec guidelines. A short overview of the results is summarized hereafter :

Zinc was found above the MENVIQ criterion in more than seventy percent (70%) on the samples. Cadmium was measured above the MENVIQ criterion in forty-five percent (45%) of the collected samples. Copper and Mercury were detected above the MENVIQ criteria in about twenty percent (20%) of the analytical samples. Nickel, Lead and Chromium were found above the MENVIQ criteria in ten percent (10%) of the samples or less. Arsenic was never found to exceed the corresponding MENVIQ criterion, but was detected in all samples and occasionally above the background levels. Iron and Selenium were detected in all samples but there are no existing MENVIQ criteria for these compounds. The most widespread of these contaminants appeared to be Zinc and Cadmium.

## **6.0            GRANDE-ILE SHORELINE SEDIMENTS CHARACTERIZATION**

### **6.1            Field Work**

The Grande-Ile nearshore sediment collection work was carried out from the surface of the ice cover from February 22 to March 4, 1993. The total number of sampling stations was seventy-three (73). Most of the stations (68) were located along Grande-Ile shoreline. Five (5) additional stations were located along the North-West shoreline of Clark Island. The location of the sampling stations is shown on Figure 2.1 (provided in Appendix C). The sampling points are identified SE-93-01 to SE-93-85<sup>1</sup>.

All samples were obtained from the ice surface by using a sampler devised by TECSULT. Because of the cold temperatures during field work, it was considered inappropriate to use a grab sampler of the Clam Shell type because of the clean-up procedures required to avoid cross-contamination.

Consequently, TECSULT devised a PVC sampler that can contain a 1 litre glass jar. Each sample was then collected directly in his own jar, thus avoiding the need for clean-up of tools. Photographies in Appendix A illustrate the TECSULT sampler.

At some locations, mainly in the northern area, no sediments were found at some sampling locations as indicated in Figure 2.1. The river bottom at these locations is covered with large boulders or is constituted of bedrock outcrop.

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<sup>1</sup> At 12 sampling locations no sediment samples were collected due to the nature of the river bottom or because water depth exceeded 1.5 m.

Table 6.1 provides the pertinent identification data for all the samples collected during the field work as well as a visual description of the samples.

## **6.2            Sampling and Testing**

At each sampling station, one sample collected directly in the jar was taken for analysis of selected heavy metals and total organic carbon. Also, one sample at most of the stations was collected and placed in a polyethylene bag for complete or partial grain size analysis.

The samples were placed in an icebox and were brought to the analytical laboratory during the sampling day.

### **6.2.1        Heavy Metals and Organic Carbon Content**

Total Arsenic, Cadmium, Copper, Mercury and Zinc concentrations were measured for each collected surface sample for a total of 73 samples. The choice of Cadmium, Copper, Mercury and Zinc in the analytical program was based on Phase III sediments characterization that showed that these parameters are those more often found above the new MENVIQ guidelines. Arsenic was chosen in the analytical program in order to update the carcinogenic risk analysis.

The Total Organic Carbon (TOC) was also measured for each sampling station for the same series of 73 samples. The measurement of TOC will be useful in selecting sampling location whether further characterization works, such as sediment bioassays, are required.



**TABLE 6.1**  
**ALLIED-SIGNAL INC - CLARK ISLAND SITE**  
**GRANDE-ILE SHORELINE SEDIMENTS CHARACTERIZATION**  
**CHARACTERISTICS OF RIVER BOTTOM SEDIMENT SAMPLES**

<b>SAMPLE NUMBER</b>	<b>WATER DEPTH (m)</b>	<b>RIVER BOTTOM ELEVATION (m)</b>	<b>DESCRIPTION</b>
SE-93-01	1.30	45.20	Organic SILT with sand, black colour, very soft, presence of vegetation and benthic species
SE-93-02	1.60	44.90	Organic SILT, black colour, very soft, presence of shells and benthic species
SE-93-03	1.20	45.30	Silty SAND with traces of gravel, black colour, presence of shells and benthic species
SE-93-04	1.50	45.00	Organic SILT with sand, black colour, soft
SE-93-05	1.35	45.15	Organic SILT with sand, black colour, very soft
SE-93-06	1.25	45.25	Organic SILT, black colour, very soft
SE-93-07	1.45	45.05	Organic SILT, black colour, very soft presence of shells
SE-93-08	1.30	45.20	Organic SILT, black colour, soft, presence of shells and important vegetation
SE-93-09	1.65	44.85	Organic SILT, black colour, very soft, presence of shells and vegetation
SE-93-10	1.40	45.10	Organic SILT, black colour, soft, presence of vegetation and benthic species
SE-93-11	1.95	44.55	Organic SILT, black colour, very soft
SE-93-12	1.60	44.90	Organic SILT, black colour, soft, presence of benthic fauna
SE-93-14	1.20	45.30	Silty SAND with some organics, brown colour presence of shells
SE-93-16	1.10	45.40	SAND with traces of silt, brown colour, presence of shells
SE-93-17	1.30	45.20	Sandy SILT with traces of gravel, firm, brown colour
SE-93-18	1.70	44.80	Sandy lean CLAY, brown colour, presence of shells and vegetation
SE-93-19	1.20	45.30	SAND, brown colour, presence of shells

**TABLE 6.1 (CONTINUED)**  
**ALLIED – SIGNAL INC – CLARK ISLAND SITE**  
**GRANDE – ILE SHORELINE SEDIMENTS CHARACTERIZATION**  
**CHARACTERISTICS OF RIVER BOTTOM SEDIMENT SAMPLES**

<b>SAMPLE NUMBER</b>	<b>WATER DEPTH (m)</b>	<b>RIVER BOTTOM ELEVATION (m)</b>	<b>DESCRIPTION</b>
SE – 93 – 20	1.70	44.80	Silty SAND with some organics, brown colour, presence of shells and vegetation
SE – 93 – 21	1.05	45.45	Sandy SILT, grey colour, firm, grey clay layer under sandy silt layer
SE – 93 – 22	1.55	44.95	Silty SAND with some organics, brown colour, presence of shells
SE – 93 – 23	1.30	45.20	Silty SAND with traces of gravel, dark grey colour, presence of shells, grey clay layer under silty sand layer
SE – 93 – 24	1.50	45.00	Silty SAND, dark grey colour, presence of shells and vegetation
SE – 93 – 25	1.30	45.20	Silty SAND, dark grey colour, presence of shells
SE – 93 – 26	1.20	45.30	SILT with sand, dark grey colour, grey clay layer under silt with sand layer
SE – 93 – 27	1.40	45.10	SILT with sand, dark grey colour, presence of shells and vegetation
SE – 93 – 28	1.30	45.20	Silty SAND, dark grey colour, presence of shells and vegetation, grey clay layer under silty sand layer
SE – 93 – 29	1.50	45.00	SILT with traces of sand and gravel, dark grey colour, grey clay layer under silt with traces of sand and gravel layer
SE – 93 – 30	1.10	45.40	SAND, brown colour, presence of shells and vegetation
SE – 93 – 31	1.50	45.00	SILT with traces of sand and gravel, dark grey colour, presence of benthic species and vegetation
SE – 93 – 32	1.00	45.50	Silty SAND, dark grey colour, presence of benthic species and vegetation
SE – 93 – 33	1.25	45.25	Sandy SILT with some gravel, dark grey colour, presence of shells
SE – 93 – 34	1.55	44.95	SILT, dark grey colour, presence of shells and vegetation, grey clay layer under silt layer
SE – 93 – 35	1.15	45.35	SAND with silt, clear brown colour presence of benthic species

TABLE 6.1 (CONTINUED)  
 ALLIED-SIGNAL INC – CLARK ISLAND SITE  
 GRANDE-ILE SHORELINE SEDIMENTS CHARACTERIZATION  
 CHARACTERISTICS OF RIVER BOTTOM SEDIMENT SAMPLES

SAMPLE NUMBER	WATER DEPTH (m)	RIVER BOTTOM ELEVATION (m)	DESCRIPTION
SE-93-36	1.50	45.00	SILT with sand, grey colour, presence of shells and benthic species
SE-93-37	1.20	45.30	Silty SAND, grey colour, presence of vegetation, grey clay layer under silty sand layer
SE-93-38	1.45	45.05	SILT with sand, grey colour, presence of vegetation
SE-93-39	1.25	45.25	Sandy SILT, grey colour, presence of benthic species and vegetation, traces of orange particles, grey clay layer under sandy silt layer
SE-93-40	1.20	45.30	Sandy SILT, grey colour, presence of vegetation
SE-93-41	1.50	45.00	Sandy SILT with some gravel, grey colour, presence of shells
SE-93-42	1.40	45.10	Sandy SILT, grey colour presence of shells
SE-93-43	1.60	44.90	SILT with sand, dark grey colour, presence of shells and vegetation, grey clay layer under silt with sand layer
SE-93-44	1.50	45.00	SILT with sand, dark grey colour, presence of shells and vegetation, grey clay layer under silt with sand layer
SE-93-45	1.70	44.80	SILT with sand, dark grey colour
SE-93-46	1.20	45.30	SILT with sand, dark grey colour, presence of shells and vegetation, firm grey clay layer under silt with sand layer
SE-93-47	1.70	44.80	Silty SAND, brown colour
SE-93-48	1.15	45.35	SAND with silt and traces of gravel, brown colour, presence of shells, organics and vegetation
SE-93-49	1.65	44.85	Silty SAND, brown colour, presence of vegetation
SE-93-50	1.20	45.30	Clayey SAND, brown colour, presence of vegetation grey clay layer under clayey sand layer
SE-93-51	1.60	44.90	Sandy SILT, dark brown colour



**TABLE 6.1 (CONTINUED)**  
**ALLIED – SIGNAL INC – CLARK ISLAND SITE**  
**GRANDE – ILE SHORELINE SEDIMENTS CHARACTERIZATION**  
**CHARACTERISTICS OF RIVER BOTTOM SEDIMENT SAMPLES**

<b>SAMPLE NUMBER</b>	<b>WATER DEPTH (m)</b>	<b>RIVER BOTTOM ELEVATION (m)</b>	<b>DESCRIPTION</b>
SE – 93 – 52	1.25	45.25	SAND, brown colour, presence of shells and vegetation
SE – 93 – 53	1.70	44.80	Silty SAND, brown colour, presence of shells
SE – 93 – 55	1.10	45.40	Silty SAND, brown colour, presence of vegetation, grey clay layer under silty sand layer
SE – 93 – 56	1.50	45.00	Sandy SILT, brown colour, presence of shells and vegetation
SE – 93 – 58	1.20	45.30	Silty SAND, brown colour
SE – 93 – 59	1.10	45.40	Lean CLAY with sand, clear brown colour, presence of vegetation
SE – 93 – 60	1.60	44.90	Silty SAND, brown colour, presence of shells and vegetation
SE – 93 – 61	1.20	45.30	Silty SAND, brown colour, presence of shells and vegetation, grey clay layer under silty sand layer
SE – 93 – 62	1.75	44.75	Silty SAND, brown colour, presence of shells and vegetation
SE – 93 – 63	1.70	44.80	Silty SAND, brown colour presence of vegetation and benthic species
SE – 93 – 64	1.20	45.30	SAND with traces of gravel, brown colour, presence of shells benthic species and boulders
SE – 93 – 65	1.05	45.45	GRAVEL with sand, dark brown colour, presence of shells and cobbles
SE – 93 – 66	1.75	44.75	BOULDERS, presence of shells, mussels and vegetation
SE – 93 – 67	1.20	45.30	BOULDERS or rock outcrop

TABLE 6.1 (CONTINUED)  
 ALLIED-SIGNAL INC - CLARK ISLAND SITE  
 GRANDE-ILE SHORELINE SEDIMENTS CHARACTERIZATION  
 CHARACTERISTICS OF RIVER BOTTOM SEDIMENT SAMPLES

SAMPLE NUMBER	WATER DEPTH (m)	RIVER BOTTOM ELEVATION (m)	DESCRIPTION
SE-93-68	1.55	44.95	BOULDERS or rock outcrop
SE-93-69	1.55	44.95	SAND with silt and gravel, dark brown colour, presence of shells, vegetation and boulders
SE-93-71	1.55	44.95	SAND with silt and gravel, brown colour, presence of shells and cobbles
SE-93-73	1.00	45.50	SAND with silt and gravel, dark brown colour, presence of organics and boulders
SE-93-74	1.90	44.60	SAND, brown colour presence of many shells and boulders
SE-93-75	1.85	44.65	SAND with silt, dark brown colour, presence of organics and vegetation
SE-93-75A	1.80	44.70	Silty SAND, dark brown colour, presence of gravel, shells and vegetation
SE-93-75B	1.50	45.00	SAND with silt, brown colour, presence of shells and boulders
SE-93-76	1.25	45.25	BOULDERS or rock outcrop
SE-93-77	2.45	44.05	Sandy SILT, dark brown colour
SE-93-78	2.30	44.20	Sandy SILT, dark brown colour
SE-93-81	0.65	45.85	Sandy SILT (pyrite cinders), dark red colour, firm
SE-93-82	0.75	45.75	Sandy SILT, dark brown colour,
SE-93-83	0.85	45.65	Sandy SILT (pyrite cinders) dark red colour, firm
SE-93-84	0.60	45.90	SILT (pyrite cinders), dark red colour, firm presence of white traces (maybe alum muds)
SE-93-85	0.70	45.80	SILT with sand, dark red colour, stiff, presence of white traces (maybe alum muds)

The chemical analytical work was subcontracted to ECO-CNFS from Pointe-Claire. Seven (7) duplicate samples were submitted to Zenon Laboratory in Ville d'Anjou. The analytical methods and the detection limits for these analyses are presented in Table 6.2.

### **6.2.2      Geotechnical Analyses**

Fifty-eight (58) samples were submitted to a partial grain size analysis, using the 80  $\mu\text{m}$  sieve. Eleven (11) samples were submitted to a complete grain size analysis. These tests have allowed to determine the grain size distribution for each sample. Also, four (4) Atterberg limit tests including liquid and plastic limits were carried out in order to better classify, in the USCS Classification, some fine sediment samples.

The sediments grain size characteristics are needed to better locate sampling stations if further characterization works, such as sediment bioassays, are required. These characteristics will also help to select equipment for further restoration works, if required.

The geotechnical work was subcontracted to Enviroconseil of Montreal.

## **7.0      GEOTECHNICAL CHARACTERISTICS OF SEDIMENTS**

The identification and characterization of the river bottom sediments was carried out in the field by a visual description of all collected samples and then in the laboratory by performing geotechnical tests. The geotechnical tests consisted in mechanical grain size analysis and Atterberg limits. Fifty-eight (58) samples were submitted to the measurement of fines content : particles finer than the 80  $\mu\text{m}$  sieve. Eleven (11) samples were submitted to a complete grain size

TABLE 6.2  
ALLIED-SIGNAL INC. - CLARK ISLAND SITE  
GRANDE-ILE SHORELINE SEDIMENTS CHARACTERIZATION  
ANALYTICAL METHODS AND DETECTION LIMITS  
TOTAL HEAVY METALS AND ORGANIC CARBON CONTENTS

PARAMETER	DIGESTION METHOD	ANALYTICAL METHOD	DETECTION LIMIT (mg/kg)
ARSENIC	HNO <sub>3</sub> +H <sub>2</sub> O <sub>2</sub>	STM-3112 (1)	0.1
CADMIUM	HNO <sub>3</sub> +H <sub>2</sub> O <sub>2</sub>	STM-3113 (1)	0.03
COPPER	HNO <sub>3</sub> +H <sub>2</sub> O <sub>2</sub>	STM-3120 (1)	1.0
MERCURY	HNO <sub>3</sub> +H <sub>2</sub> SO <sub>4</sub> + +KmNO <sub>4</sub> +K <sub>2</sub> S <sub>2</sub> O <sub>8</sub>	BEST-1979 (2)	0.02
ZINC	HNO <sub>3</sub> +H <sub>2</sub> O <sub>2</sub>	STM-3120 (1)	1.0
TOTAL ORGANIC CARBON	HCL	Environnement Canada (3)	0.01 %

NOTE: (1) STM: Standard methods for the examination of water and wastewater, 17th edition, 1989

(2) BEST: Study board on toxic substances, MENVIQ

(3) Method proposed by Environnement Canada



distribution test for coarse size particles. Out of these eleven samples, four (4) were submitted to the determination of Atterberg limits (liquid limit and plastic limit). The geotechnical test results are presented in Table 7.1. Grain size distribution curves are presented in Appendix B.

Based on field description and the interpretation of the geotechnical test results, sediments may be divided into three categories.

- Pyrite cinders (Priority Zone I)
- Fine sediments (Priority Zone II)
- Coarse sediments (Priority Zone II)

A- Pyrite cinders (Priority Zone I)

Pyrite cinders are located close to Clark Island along its North-West shore and around the Northern tip of the island. The deposit consists of a red oxidized material with mostly silt-sized particles.

B- Fine sediments (Priority Zone II)

It is a material containing between 50 and 99% fine sized particles (i.e. less than 80  $\mu\text{m}$ ). Thirty-one (31) out of sixty-four (64) samples collected along Grande-Ile shoreline are fine sized soils, representing 48% of the samples collected. From the Clark Island causeway to the sampling station SE-93-12, the sediments have an organic appearance and a black colour. From station SE-93-12 downstream, the fine sediments are generally constituted of sandy silt to silt with traces of sand. They are of dark grey colour.

TABLE 7.1  
ALLIED-SIGNAL INC -- CLARK ISLAND SITE  
GRANDE-ILE SHORELINE SEDIMENTS CHARACTERIZATION  
GEOTECHNICAL TEST RESULTS

SAMPLE NUMBER	WATER DEPTH (m)	RIVER BOTTOM ELEVATION (m)	GRAIN SIZE			LIQUID LIMIT (%)	PLASTIC LIMIT (%)	USCS CLASSIFI- CATION (1)
			CLAY & SILT (%)	SAND (%)	GRAVEL (%)			
SE-93-02	1.60	44.90	96.4	3.4	0.2	-	-	OL or OH (2)
SE-93-03	1.20	45.30	43.3	56.7		-	-	-
SE-93-05	1.35	45.15	80.8	19.2		-	-	-
SE-93-06	1.25	45.25	91.8	8.2		-	-	-
SE-93-07	1.45	45.05	97.4	2.6		-	-	-
SE-93-08	1.30	45.20	93.9	6.1		-	-	-
SE-93-09	1.65	44.85	98.7	1.3		-	-	-
SE-93-10	1.40	45.10	97.8	2.2		-	-	-
SE-93-11	1.95	44.55	98.6	1.4		-	-	-
SE-93-12	1.60	44.90	88.5	11.5		-	-	-
SE-93-14	1.20	45.30	28.2	69.7	2.1	-	-	SM or SC (3)
SE-93-16	1.10	45.40	5.5	94.5		-	-	-
SE-93-17	1.30	45.20	59.9	40.1		-	-	-
SE-93-18	1.70	44.80	64.8	35.0	0.2	35.7	18.0	CL (4)
SE-93-19	1.20	45.30	4.3	95.7		-	-	-
SE-93-20	1.70	44.80	40.2	59.8		-	-	-
SE-93-21	1.05	45.45	67.8	32.2		-	-	-
SE-93-22	1.55	44.95	34.9	65.1		-	-	-
SE-93-23	1.30	45.20	19.0	68.3	12.7	-	-	SM or SC (3)
SE-93-24	1.50	45.00	16.5	83.5		-	-	-

TABLE 7.1 (CONTINUED)  
 ALLIED-SIGNAL INC - CLARK ISLAND SITE  
 GRANDE-ILE SHORELINE SEDIMENTS CHARACTERIZATION  
 GEOTECHNICAL TEST RESULTS

SAMPLE NUMBER	WATER DEPTH (m)	RIVER BOTTOM ELEVATION (m)	GRAIN SIZE			LIQUID LIMIT (%)	PLASTIC LIMIT (%)	USCS CLASSIFI- CATION (1)
			CLAY & SILT (%)	SAND (%)	GRAVEL (%)			
SE-93-25	1.30	45.20	17.2	82.8		-	-	-
SE-93-26	1.20	45.30	81.5	18.5		-	-	-
SE-93-27	1.40	45.10	83.9	16.1		-	-	-
SE-93-28	1.30	45.20	48.3	51.7		-	-	-
SE-93-29	1.50	45.00	92.9	7.1		-	-	-
SE-93-30	1.10	45.40	3.1	96.9		-	-	-
SE-93-31	1.50	45.00	90.7	9.3		-	-	-
SE-93-32	1.00	45.50	30.8	67.9	1.3	-	-	SM or SC (3)
SE-93-33	1.25	45.25	68.2	31.8		-	-	-
SE-93-34	1.55	44.95	90.7	9.3		-	-	-
SE-93-35	1.15	45.35	10.2	89.8		-	-	-
SE-93-36	1.50	45.00	78.6	21.4		-	-	-
SE-93-37	1.20	45.30	35.8	64.2		-	-	-
SE-93-38	1.45	45.05	83.9	15.0	1.1	54.5	21.2	MH (5)
SE-93-39	1.25	45.25	52.6	47.4		-	-	-
SE-93-40	1.20	45.30	65.4	34.6		-	-	-
SE-93-41	1.50	45.00	65.5	34.5		-	-	-
SE-93-42	1.40	45.10	52.4	47.6		-	-	-
SE-93-43	1.60	44.90	78.2	21.8		-	-	-
SE-93-44	1.50	45.00	81.3	18.7		-	-	-

TABLE 7.1 (CONTINUED)  
 ALLIED-SIGNAL INC - CLARK ISLAND SITE  
 GRANDE-ILE SHORELINE SEDIMENTS CHARACTERIZATION  
 GEOTECHNICAL TEST RESULTS

SAMPLE NUMBER	WATER DEPTH (m)	RIVER BOTTOM ELEVATION (m)	GRAIN SIZE			LIQUID LIMIT (%)	PLASTIC LIMIT (%)	USCS CLASSIFI- CATION (1)
			CLAY & SILT (%)	SAND (%)	GRAVEL (%)			
SE-93-45	1.70	44.80	64.7	25.3		-	-	-
SE-93-46	1.20	45.30	83.6	16.4		-	-	-
SE-93-47	1.70	44.80	27.5	72.5		-	-	-
SE-93-48	1.15	45.35	8.9	91.1		-	-	-
SE-93-49	1.65	44.85	25.7	74.3		-	-	-
SE-93-50	1.20	45.30	48.3	50.7	1.0	34.2	13.9	SC (3)
SE-93-51	1.60	44.90	58.3	41.7		-	-	-
SE-93-52	1.25	45.25	3.2	96.8		-	-	-
SE-93-53	1.70	44.80	26.7	73.3		-	-	-
SE-93-55	1.10	45.40	43.2	56.8		-	-	-
SE-93-56	1.50	45.00	51.4	48.6		-	-	-
SE-93-58	1.20	45.30	12.7	87.3		-	-	-
SE-93-59	1.10	45.40	80.9	18.9	0.2	43.0	16.1	CL (4)
SE-93-60	1.60	44.90	21.7	78.3		-	-	-
SE-93-61	1.20	45.30	28.2	71.8		-	-	-
SE-93-62	1.75	44.75	46.3	53.7		-	-	-
SE-93-63	1.70	44.80	16.0	83.6	0.4	-	-	SM or SC (3)
SE-93-64	1.20	45.30	4.0	96.0		-	-	-
SE-93-65	1.05	45.45	1.6	98.4		-	-	-
SE-93-69	1.55	44.95	9.0	91.0		-	-	-



TABLE 7.1 (CONTINUED)  
ALLIED-SIGNAL INC - CLARK ISLAND SITE  
GRANDE-ILE SHORELINE SEDIMENTS CHARACTERIZATION  
GEOTECHNICAL TEST RESULTS

SAMPLE NUMBER	WATER DEPTH (m)	RIVER BOTTOM ELEVATION (m)	GRAIN SIZE			LIQUID LIMIT (%)	PLASTIC LIMIT (%)	USCS CLASSIFI- CATION (1)
			CLAY & SILT (%)	SAND (%)	GRAVEL (%)			
SE-93-71	1.55	44.95	9.2	90.8		-	-	-
SE-93-75	1.85	44.65	11.6	88.4		-	-	-
SE-93-75A	1.80	44.70	25.6	70.6	3.8	-	-	SM or SC (3)
SE-93-75B	1.50	45.00	10.0	90.0		-	-	-
SE-93-81	0.65	45.85	64.8	35.2		-	-	-
SE-93-82	0.75	45.75	60.7	39.3		-	-	-
SE-93-83	0.85	45.65	90.8	9.2	0.0	-	NP (6)	ML (7)
SE-93-84	0.60	45.90	93.4	6.6		-	-	-
SE-93-85	0.70	45.80	84.3	15.7		-	-	-

(1) USCS: UNIFIED SOIL CLASSIFICATION SYSTEM

(2) OL: ORGANIC CLAY OR SILT WITH A LIQUID LIMIT < 50

OH: ORGANIC CLAY OR SILT WITH A LIQUID LIMIT ≥ 50

(3) SM: SILTY SAND (SANDS WITH MORE THAN 12% FINES)

SC: CLAYEY SAND (SANDS WITH MORE THAN 12% FINES)

(4) CL: LEAN CLAY

(5) MH: ELASTIC SILT

(6) NP: NON PLASTIC

(7) ML: SILT

### C- Coarse sediments

Coarse sediments are mostly found in the area downstream of the island. The material contains between 1 to 48% fine sized particles. It has a natural appearance and is typically a silty sand. Thirty-three (33) out of sixty-four (64) samples collected along Grande-Ile shoreline are constituted of coarse soils, representing 52% of the samples collected.

## 8.0 CHEMICAL CHARACTERISTICS OF SEDIMENTS

### 8.1 Heavy Metals and Organic Carbon Contents

As mentioned previously, seventy-three (73) samples were tested for Arsenic, Cadmium, Copper, Mercury, Zinc and Total Organic Carbon concentrations. The analytical test results are presented in Table 8.1.

In order to assess the quality of the sediments, the interim criteria proposed by MENVIQ (Table 3.1) have been used. Table 8.2 indicates the number of samples that were found above the MENVIQ level 3 criteria.

### Arsenic

The Arsenic concentrations along Grande-Ile shoreline (Priority Zone II) vary from 0.7 to 107.0 mg/kg, with an average concentration of 18.2 mg/kg. In the contaminated area, where concentrations are above MENVIQ criterion (17.0 mg/kg), the average Arsenic value is 48.0 mg/kg. The highest Arsenic concentration (107.0 mg/kg) in Priority Zone II was found in the North-East Bay (sample SE-93-02).



TABLE 8.1  
ALLIED-SIGNAL INC - CLARK ISLAND SITE  
GRANDE-ILE SHORELINE SEDIMENTS CHARACTERIZATION  
CHEMICAL TEST RESULTS

SAMPLE NUMBER	WATER DEPTH (m)	RIVER BOTTOM ELEVATION (m)	METALS CONCENTRATION (mg/kg)					TOTAL ORGANIC CARBON (%)
			As	Cd	Cu	Hg	Zn	
SE-93-01	1.30	45.20	52.00	57.00	293.00	6.46	13 000.00	15.69
SE-93-02	1.60	44.90	107.00	39.00	514.00	2.77	8 100.00	7.14
SE-93-03	1.20	45.30	20.00	14.00	162.00	3.10	2 830.00	6.32
SE-93-04	1.50	45.00	94.00	6.00	210.00	1.12	1 450.00	5.61
SE-93-05	1.35	45.15	44.00	45.00	390.00	3.79	9 100.00	6.58
SE-93-06	1.25	45.25	47.00	49.00	311.00	7.40	11 000.00	5.81
SE-93-07	1.45	45.05	85.00	44.00	425.00	7.20	9 500.00	5.12
SE-93-08	1.30	45.20	58.00	49.00	511.00	8.00	1 000.00	4.82
SE-93-09	1.65	44.85	92.00	67.00	458.00	9.40	15 000.00	5.12
SE-93-10	1.40	45.10	68.00	46.00	333.00	5.46	9 800.00	4.20
SE-93-11	1.95	44.55	79.00	63.00	437.00	11.20	13 000.00	4.78
SE-93-12	1.60	44.90	38.00	14.00	208.00	3.09	3 400.00	3.28
SE-93-14	1.20	45.30	12.00	12.00	86.00	1.12	2 330.00	4.37
SE-93-16	1.10	45.40	2.70	1.00	9.00	0.06	345.00	0.22
SE-93-17	1.30	45.20	19.00	7.00	52.00	0.40	2 620.00	0.77
MENVIQ LEVEL 3 CRITERION			17.00	3.00	86.00	1.00	540.00	—

NOTE :



RESULT ABOVE MENVIQ LEVEL 3 CRITERION



TABLE 8.1 (CONTINUED)  
ALLIED-SIGNAL INC - CLARK ISLAND SITE  
GRANDE-ILE SHORELINE SEDIMENTS CHARACTERIZATION  
CHEMICAL TEST RESULTS

SAMPLE NUMBER	WATER DEPTH (m)	RIVER BOTTOM ELEVATION (m)	METALS CONCENTRATION (mg/kg)					TOTAL ORGANIC CARBON (%)
			As	Cd	Cu	Hg	Zn	
SE-93-18	1.70	44.80	25.00	12.00	107.00	2.69	2 530.00	1.74
SE-93-19	1.20	45.30	2.00	0.65	7.00	<0.02	186.00	0.14
SE-93-20	1.70	44.80	23.00	13.00	103.00	3.30	2 460.00	0.34
SE-93-21	1.05	45.45	11.10	0.69	52.00	<0.02	253.00	0.56
SE-93-22	1.55	44.95	10.20	6.30	44.00	1.13	928.00	1.21
SE-93-23	1.30	45.20	7.60	2.60	24.00	0.34	701.00	2.35
SE-93-24	1.50	45.00	5.00	1.62	23.00	0.21	467.00	0.33
SE-93-25	1.30	45.20	4.50	2.56	12.00	0.43	745.00	0.40
SE-93-26	1.20	45.30	4.00	1.83	18.00	0.33	880.00	0.30
SE-93-27	1.40	45.10	51.00	3.78	66.00	0.56	4 133.00	0.50
SE-93-28	1.30	45.20	8.00	1.55	26.00	0.30	1 600.00	0.29
SE-93-29	1.50	45.00	55.00	1.79	70.00	0.10	4 575.00	0.49
SE-93-30	1.10	45.40	1.40	0.49	5.00	<0.02	207.00	0.11
SE-93-31	1.50	45.00	43.00	1.50	61.00	0.07	3 540.00	0.37
SE-93-32	1.00	45.50	1.70	0.49	7.00	<0.02	234.00	0.12
MENVIQ LEVEL 3 CRITERION	-	-	17.00	3.00	86.00	1.00	540.00	-

NOTE :   RESULT ABOVE MENVIQ LEVEL 3 CRITERION

TABLE 8.1 (CONTINUED)  
ALLIED-SIGNAL INC - CLARK ISLAND SITE  
GRANDE-ILE SHORELINE SEDIMENTS CHARACTERIZATION  
CHEMICAL TEST RESULTS

SAMPLE NUMBER	WATER DEPTH (m)	RIVER BOTTOM ELEVATION (m)	METALS CONCENTRATION (mg/kg)					TOTAL ORGANIC CARBON (%)
			As	Cd	Cu	Hg	Zn	
SE-93-33	1.25	45.25	1.20	1.10	15.00	0.05	1 210.00	0.16
SE-93-34	1.55	44.95	36.00	2.10	69.00	0.22	3 470.00	0.50
SE-93-35	1.15	45.35	1.80	0.47	5.00	0.05	311.00	0.18
SE-93-36	1.50	45.00	35.00	1.90	64.00	0.17	3 750.00	0.53
SE-93-37	1.20	45.30	2.40	0.48	8.00	0.10	301.00	0.19
SE-93-38	1.45	45.05	23.00	2.30	59.00	0.41	3 170.00	0.54
SE-93-39	1.25	45.25	1.80	0.47	8.00	0.08	263.00	0.17
SE-93-40	1.20	45.30	1.40	0.42	8.00	<0.02	213.00	0.13
SE-93-41	1.50	45.00	17.00	1.70	33.00	0.07	1 850.00	0.67
SE-93-42	1.40	45.10	0.70	1.20	22.00	0.14	815.00	0.41
SE-93-43	1.60	44.90	29.00	1.20	51.00	0.21	1 980.00	0.60
SE-93-44	1.50	45.00	2.50	0.46	21.00	0.13	251.00	0.20
SE-93-45	1.70	44.80	12.00	1.89	35.00	0.59	1 470.00	0.64
SE-93-46	1.20	45.30	2.90	0.54	14.00	0.42	299.00	0.26
SE-93-47	1.70	44.80	1.40	0.36	10.00	0.10	104.00	0.29
MENVIQ LEVEL 3 CRITERION	-		17.00	3.00	86.00	1.00	540.00	

NOTE :



RESULT ABOVE MENVIQ LEVEL 3 CRITERION

TABLE 8.1 (CONTINUED)  
ALLIED-SIGNAL INC - CLARK ISLAND SITE  
GRANDE-ILE SHORELINE SEDIMENTS CHARACTERIZATION  
CHEMICAL TEST RESULTS

SAMPLE NUMBER	WATER DEPTH (m)	RIVER BOTTOM ELEVATION (m)	METALS CONCENTRATION (mg/kg)					TOTAL ORGANIC CARBON (%)
			As	Cd	Cu	Hg	Zn	
SE-93-48	1.15	45.35	1.30	0.44	4.00	0.11	127.00	0.15
SE-93-49	1.65	44.85	1.30	0.32	6.00	0.16	96.00	0.37
SE-93-50	1.20	45.30	1.30	0.60	5.00	0.08	129.00	0.18
SE-93-51	1.60	44.90	0.90	0.21	4.00	0.18	65.00	0.33
SE-93-52	1.25	45.25	1.10	1.52	5.00	0.10	171.00	0.08
SE-93-53	1.70	44.80	1.10	0.10	4.00	<0.02	36.00	0.61
SE-93-55	1.10	45.40	1.00	0.68	5.00	0.10	130.00	0.25
SE-93-56	1.50	45.00	1.30	0.75	6.00	0.03	207.00	0.33
SE-93-58	1.20	45.30	0.90	1.01	4.00	<0.02	168.00	0.08
SE-93-59	1.10	45.40	2.10	0.25	25.00	<0.02	117.00	0.41
SE-93-60	1.60	44.90	1.50	1.49	12.00	0.10	320.00	0.32
SE-93-61	1.20	45.30	1.70	1.15	6.00	<0.02	194.00	0.32
SE-93-62	1.75	44.75	2.20	1.51	16.00	0.13	364.00	0.58
SE-93-63	1.70	44.80	1.80	1.17	15.00	0.93	241.00	0.34
SE-93-64	1.20	45.30	1.30	0.67	9.00	<0.02	141.00	1.64
MENVIQ LEVEL 3 CRITERION			17.00	3.00	86.00	1.00	540.00	

NOTE :   RESULT ABOVE MENVIQ LEVEL 3 CRITERION



TABLE 8.1 (CONTINUED)  
ALLIED-SIGNAL INC - CLARK ISLAND SITE  
GRANDE-ILE SHORELINE SEDIMENTS CHARACTERIZATION  
CHEMICAL TEST RESULTS

SAMPLE NUMBER	WATER DEPTH (m)	RIVER BOTTOM ELEVATION (m)	METALS CONCENTRATION (mg/kg)					TOTAL ORGANIC CARBON (%)
			As	Cd	Cu	Hg	Zn	
SE-93-65	1.05	45.45	4.90	0.55	11.00	<0.02	161.00	3.64
SE-93-69	1.55	44.95	3.40	1.23	19.00	0.12	284.00	1.20
SE-93-71	1.55	44.95	5.60	4.61	16.00	0.14	318.00	2.59
SE-93-73	1.00	45.50	12.00	1.46	28.00	0.14	759.00	0.51
SE-93-74	1.90	44.60	3.70	4.10	25.00	0.24	572.00	4.07
SE-93-75	1.85	44.65	1.30	0.48	7.00	0.08	128.00	0.41
SE-93-75A	1.80	44.70	4.00	4.04	36.00	0.54	488.00	1.79
SE-93-75B	1.50	45.00	2.30	2.41	12.00	0.37	303.00	0.99
SE-93-81	0.65	45.85	86.00	18.00	1 160.00	50.00	3 010.00	0.21
SE-93-82	0.75	45.75	110.00	16.00	1 310.00	20.00	3 670.00	0.17
SE-93-83	0.85	45.65	155.00	12.00	1 140.00	1.61	2 960.00	0.30
SE-93-84	0.60	45.90	113.00	6.16	1 190.00	1.37	2 210.00	0.11
SE-93-85	0.70	45.80	136.00	20.00	1 140.00	5.57	4 760.00	0.17
MENVIQ LEVEL 3 CRITERION			17.00	3.00	86.00	1.00	540.00	

NOTE :  RESULT ABOVE MENVIQ LEVEL 3 CRITERION

TABLE 8.2  
 ALLIED-SIGNAL INC. - CLARK ISLAND SITE  
 GRANDE-ILE SHORELINE SEDIMENTS CHARACTERIZATION  
 SUMMARY OF CHEMICAL RESULTS

PARAMETER	SAMPLES ABOVE MENVIQ LEVEL 3 CRITERIA IN PRIORITY ZONE II	
	NUMBER OF SAMPLES	PERCENTAGE OF EXCEEDANCES (%)
ARSENIC	22	32.4
CADMIUM	21	30.9
COPPER	14	20.6
MERCURY	16	23.5
ZINC	34	50.0



Along Grande-Ile shoreline, Arsenic is found above the MENVIQ level 3 criterion (17.0 mg/kg) in 32% of the samples. The extent of the surface area along Priority Zone II containing Arsenic above the new Quebec guidelines is illustrated in Figure 8.1.

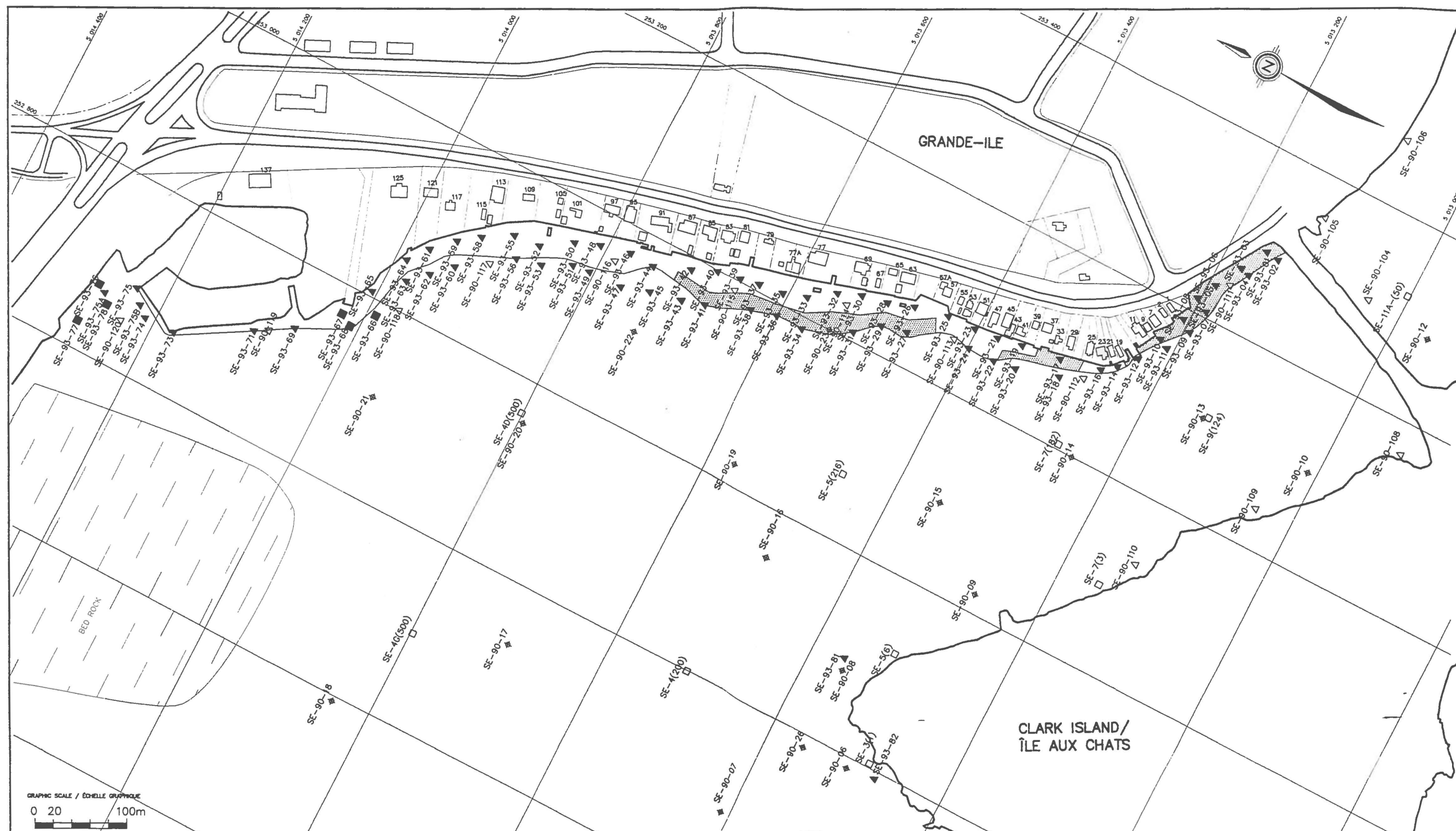
Only six (6) Arsenic measured concentrations were found between the background value of 5.4 mg/kg and the MENVIQ level 3 criterion. Thus, the remaining forty (40) samples, representing 59% of all collected samples in Priority Zone II, have Arsenic concentrations below background level.

The five (5) samples collected along the North-West shoreline of Clark Island (Priority Zone I) have all Arsenic concentrations above MENVIQ level 3 criterion. The measured Arsenic values in this zone vary from 86.0 to 155.0 mg/kg.

### **Cadmium**

The Cadmium concentrations along Grande-Ile shoreline vary from 0.1 to 67.0 mg/kg with an average concentration of 9.0 mg/kg. The average concentration of the samples where Cadmium concentrations were found above the MENVIQ level 3 criterion (3.0 mg/kg) is 27.0 mg/kg. The highest Cadmium concentration (67.0 mg/kg) in Priority Zone II was found in the North-East Bay (sample SE-93-09).

Along Grande-Ile shoreline, Cadmium is found above MENVIQ level 3 criterion (3.0 mg/kg) in 31% of the samples. The extent of the surface area along Priority Zone II containing Cadmium above the new Quebec guidelines is illustrated in Figure 8.2.



GRAPHIC SCALE / ÉCHELLE GRAPHIQUE  
0 20 100m

# LEGEND/LÉGENDE :

ARSENIC CONCENTRATION  
ABOVE MENVQ  
LEVEL 3 CRITERION

- SE-9(124) □ SURFACE SEDIMENTS SAMPLING STATION/  
STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS  
DE SURFACE (JANUARY/JANVIER 1988)
- SE-90-13 ⊕ SEDIMENTS BOREHOLE/  
FORAGE AU TRAVERS DES SÉDIMENTS  
(FEBRUARY/FÉVRIER 1990)
- SE-90-112 △ SURFACE SEDIMENTS SAMPLING STATION/  
STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS  
DE SURFACE (JUNE/JUIN 1990)

- SE-93-01 ▲ SURFACE SEDIMENTS SAMPLING STATION/  
STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS  
DE SURFACE (FEBRUARY/FÉVRIER 1993)
- SE-93-66 ■ SAMPLING STATION WHERE NO SEDIMENTS  
WERE RECOVERED / STATION D'ÉCHANTIL-  
LONNAGE DES SÉDIMENT DE SURFACE SANS  
RÉCUPÉRATION (FEBRUARY/FÉVRIER 1993)

**Allied Signal**  
**ENGINEERED  
MATERIALS**

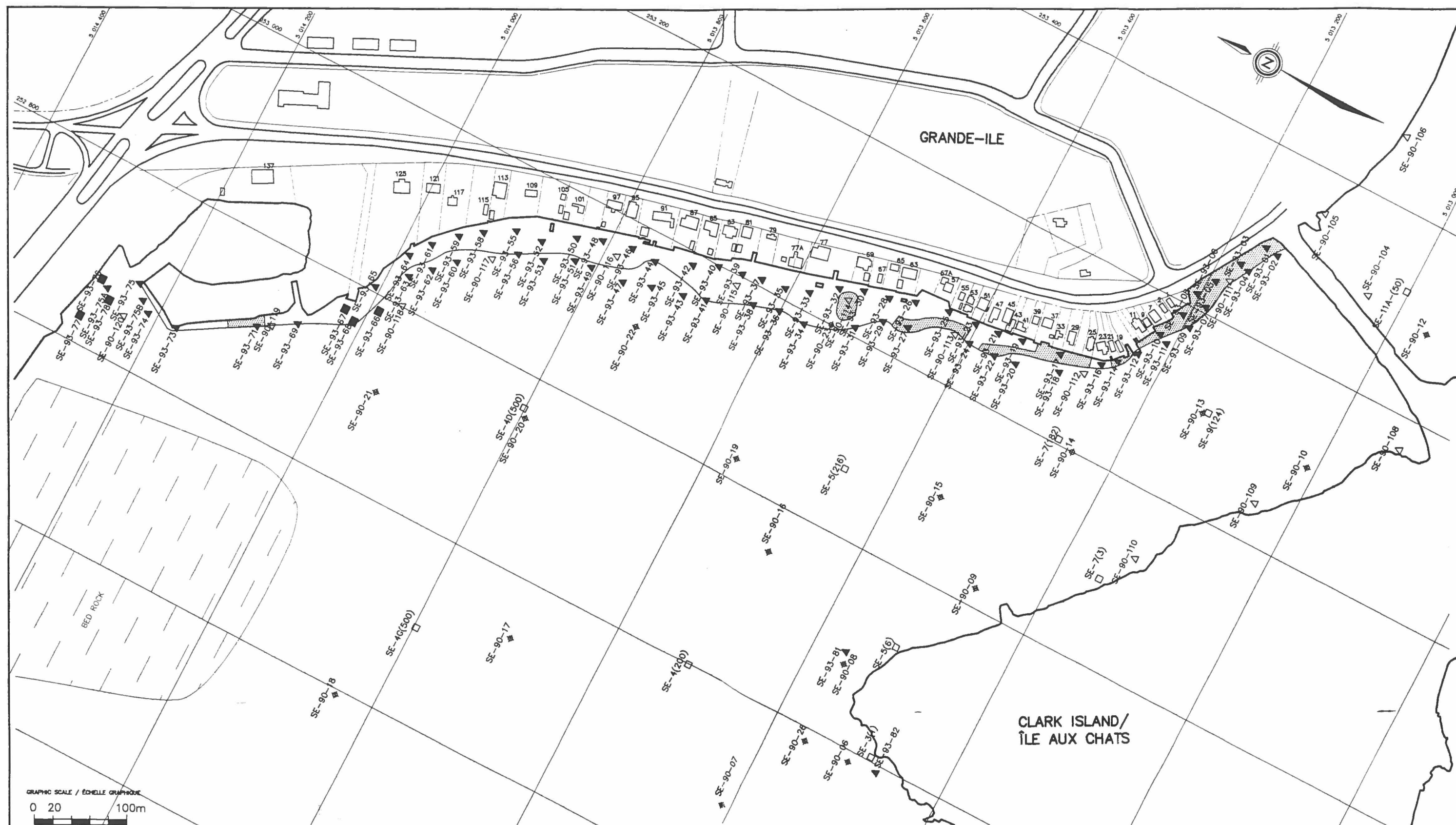
N° contrat/contract  
4361-1000

Echelle / Scale  
1:4000

Date  
APRIL 1993

EXTENT OF SEDIMENTS  
CONTAMINATION ALONG  
GRANDE-ILE SHORELINE  
ARSENIC

FIGURE : 8.1



GRAPHIC SCALE / ÉCHELLE GRAPHIQUE  
0 20 100m

LEGEND / LÉGENDE :

CADMIUM CONCENTRATION  
ABOVE MENVQ  
LEVEL 3 CRITERION

- SE-9(124) □ SURFACE SEDIMENTS SAMPLING STATION/  
STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS  
DE SURFACE (JANUARY/JANVIER 1988)
- SE-90-13 ⊕ SEDIMENTS BOREHOLE/  
FORAGE AU TRAVERS DES SÉDIMENTS  
(FEBRUARY/FÉVRIER 1990)
- SE-90-112 △ SURFACE SEDIMENTS SAMPLING STATION/  
STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS  
DE SURFACE (JUNE/JUIN 1990)

- SE-93-01 ▲ SURFACE SEDIMENTS SAMPLING STATION/  
STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS  
DE SURFACE (FEBRUARY/FÉVRIER 1993)
- SE-93-66 ■ SAMPLING STATION WHERE NO SEDIMENTS  
WERE RECOVERED / STATION D'ÉCHAN-  
TILLONNAGE DES SÉDIMENT DE SURFACE SANS  
RÉCUPÉRATION (FEBRUARY/FÉVRIER 1993)

**Allied Signal**  
ENGINEERED  
MATERIALS

N° contrat/contract  
4361-1000

Échelle / Scale  
1:4000

Date  
APRIL 1993

EXTENT OF SEDIMENTS  
CONTAMINATION ALONG  
GRANDE-ILE SHORELINE  
CADMIUM

FIGURE : 8.2

The highest background Cadmium value measured in 1990 was 4.3 mg/kg. Thus, 26% of all collected samples in Priority Zone II have Cadmium concentration above background value.

All the samples collected in Priority Zone I have Cadmium concentrations above MENVIQ level 3 criterion. The measured Cadmium values in this zone vary from 6.2 to 20.0 mg/kg.

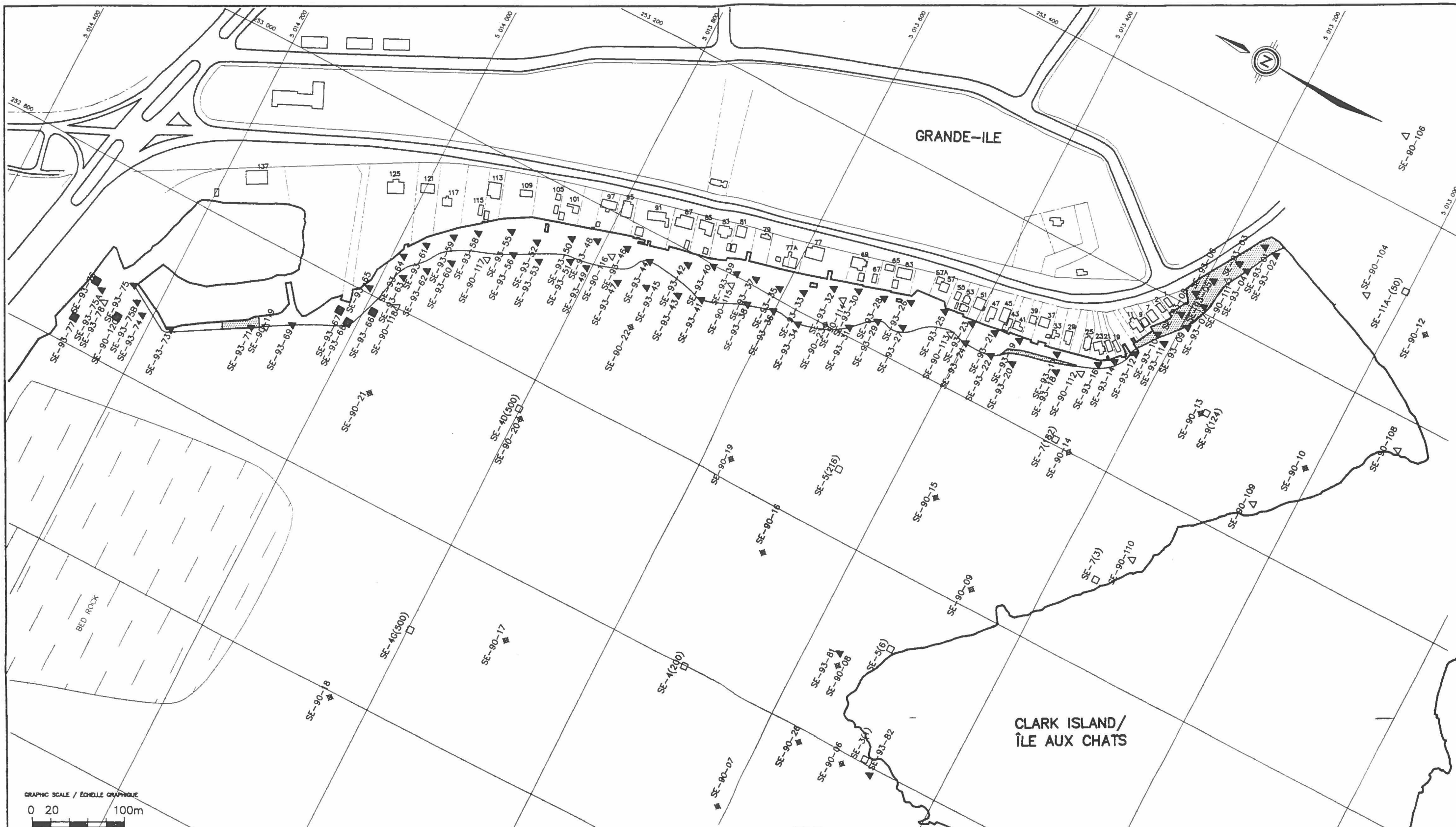
### **Copper**

The Copper concentrations along Grande-Ile shoreline vary from 4.0 to 514.0 mg/kg with an average concentration of 83.3 mg/kg. For the areas where concentrations are above MENVIQ level 3 criterion (86.0 mg/kg), the average Copper concentration value is 314.0 mg/kg. The highest Copper concentration (514.0 mg/kg) in Priority Zone II was found in the North-East Bay (sample SE-93-02).

Along Grande-Ile shoreline, Copper is found above the MENVIQ level 3 criterion (86.0 mg/kg) in 21% of the samples. The extent of the surface area along Priority Zone II containing Copper above the new Quebec guidelines is illustrated in Figure 8.3.

Only six (6) Copper measured concentrations were found above the background value of 59.0 mg/kg and below the MENVIQ level 3 criterion. Thus, the remaining forty-eight (48) samples, representing 71% of all collected samples in Priority Zone II, have Copper concentrations below background level.





GRAPHIC SCALE / ÉCHELLE GRAPHIQUE  
0 20 100m

LEGEND / LÉGENDE :

COPPER CONCENTRATION ABOVE MENVIQ LEVEL 3 CRITERION

- SE-9(124) SURFACE SEDIMENTS SAMPLING STATION / STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS DE SURFACE (JANUARY/JANVIER 1988)
- SE-90-13 SEDIMENTS BOREHOLE / FORAGE AU TRAVERS DES SÉDIMENTS (FEBRUARY/FÉVRIER 1990)
- SE-90-112 SURFACE SEDIMENTS SAMPLING STATION / STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS DE SURFACE (JUNE/JUIN 1990)

- SE-93-01 SURFACE SEDIMENTS SAMPLING STATION / STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS DE SURFACE (FEBRUARY/FÉVRIER 1993)
- SE-93-66 SAMPLING STATION WHERE NO SEDIMENTS WERE RECOVERED / STATION D'ÉCHANTILLONNAGE DES SÉDIMENT DE SURFACE SANS RÉCUPÉRATION (FEBRUARY/FÉVRIER 1993)

**Allied Signal**  
**ENGINEERED MATERIALS**

N° contrat/contract  
4361-1000

Échelle / Scale  
1:4000

Date  
APRIL 1993

EXTENT OF SEDIMENTS  
CONTAMINATION ALONG  
GRANDE-ÎLE SHORELINE  
COPPER

FIGURE : 8.3



The five (5) samples collected along the North-West shoreline of Clark Island (Priority Zone I) have all Copper concentrations above MENVIQ level 3 criterion. The measured Copper values in this zone vary from 1 140.0 to 1 310.0 mg/kg.

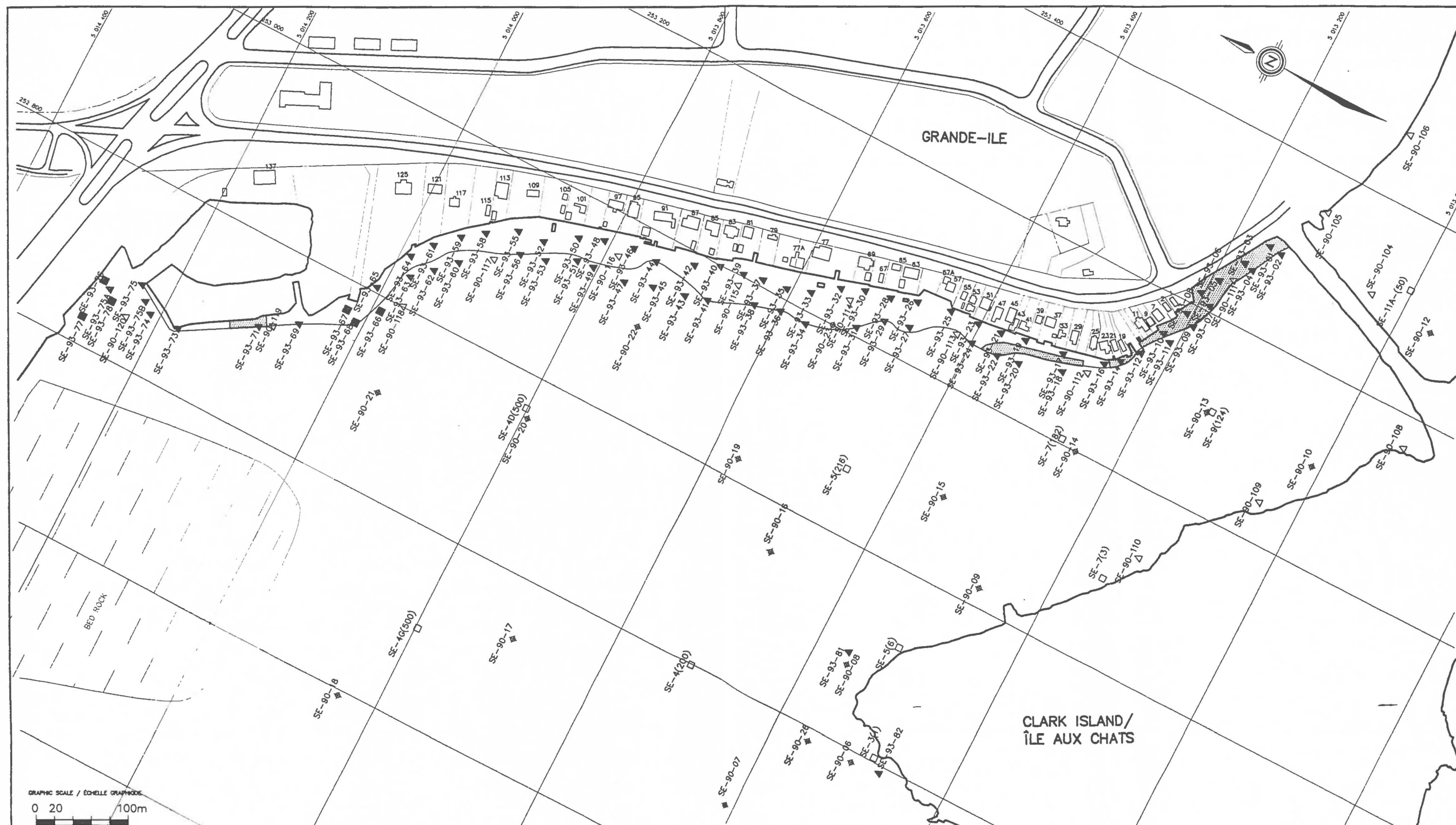
### **Mercury**

The Mercury concentrations along Grande-Ile shoreline vary from <0.02 to 11.2 mg/kg with an average concentration of 1.3 mg/kg. The average concentration of the samples where Mercury concentrations were found above the MENVIQ level 3 criterion (1.0 mg/kg) is 4.8 mg/kg. The highest Mercury concentration (11.2 mg/kg) in Priority Zone II was found in the North-East Bay (sample SE-93-11).

Along Grande-Ile shoreline, Mercury is found above the MENVIQ level 3 criterion (1.0 mg/kg) in 24% of the samples. The extent of the surface area along Priority Zone II containing Mercury above the new Quebec guidelines is illustrated in Figure 8.4.

The highest background Mercury value measured in 1990 was 1.94 mg/kg. Thus, 19% of all collected samples in Priority Zone II have Mercury concentrations above background value.

All the five (5) samples collected in Priority Zone I have Mercury concentrations above MENVIQ level 3 criterion. The measured Mercury values in this zone vary from 1.37 to 50.0 mg/kg.



# LEGEND/LÉGENDE :

MERCURY CONCENTRATION ABOVE MENVQ LEVEL 3 CRITERION

- SE-9(124) SURFACE SEDIMENTS SAMPLING STATION / STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS DE SURFACE (JANUARY/JANVIER 1988)
- SE-90-13 SEDIMENTS BOREHOLE / FORAGE AU TRAVERS DES SÉDIMENTS (FEBRUARY/FÉVRIER 1990)
- SE-90-112 SURFACE SEDIMENTS SAMPLING STATION / STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS DE SURFACE (JUNE/JUIN 1990)

- SE-93-01 SURFACE SEDIMENTS SAMPLING STATION / STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS DE SURFACE (FEBRUARY/FÉVRIER 1993)
- SE-93-66 SAMPLING STATION WHERE NO SEDIMENTS WERE RECOVERED / STATION D'ÉCHANTILLONNAGE DES SÉDIMENT DE SURFACE SANS RÉCUPÉRATION (FEBRUARY/FÉVRIER 1993)

**Allied Signal**  
ENGINEERED MATERIALS

N° contrat/contract  
4361-1000

Échelle / Scale  
1:4000

Date  
APRIL 1993

EXTENT OF SEDIMENTS  
CONTAMINATION ALONG  
GRANDE-ÎLE SHORELINE  
MERCURY

FIGURE : 8.4

## **Zinc**

The Zinc concentrations along Grande-Ile shoreline (Priority Zone II) vary from 36 to 98 000 mg/kg with an average concentration of 3 516 mg/kg. In the contaminated area, where concentrations are above MENVIQ criterion (540 mg/kg), the average Zinc concentration value is 6 808 mg/kg. The highest Zinc concentration (98 000 mg/kg) in Priority Zone II was found in the North-East Bay (sample SE-93-10).

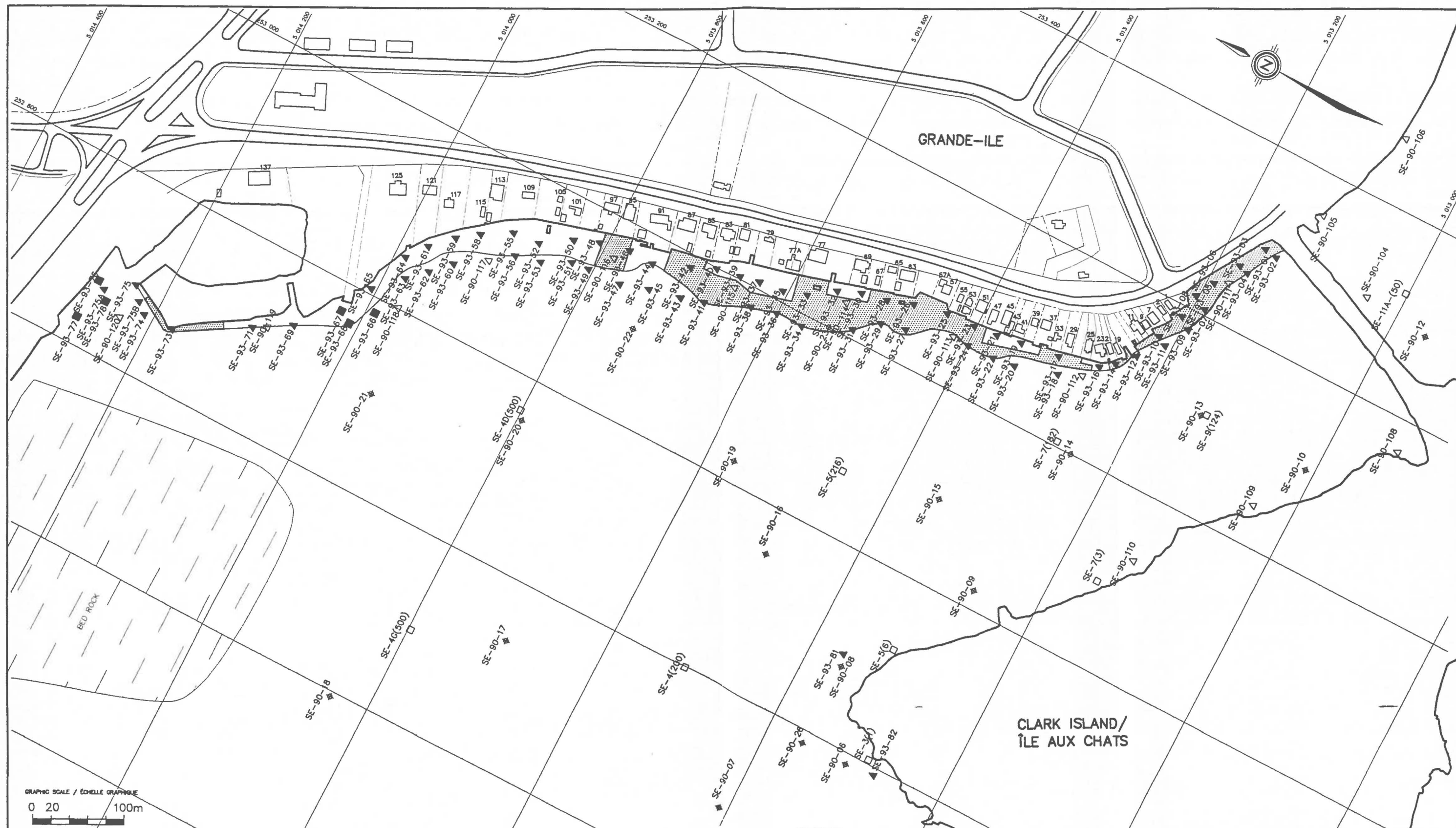
Along Grande-Ile shoreline, Zinc is found above the MENVIQ level 3 criterion (540 mg/kg) in 50% of the samples. The extent of the surface area along Priority Zone II containing Zinc above the new Quebec guidelines is illustrated in Figure 8.5.

Only two (2) Zinc measured concentrations were found above the background value of 384 mg/kg and below the MENVIQ level 3 criterion. Thus, 47% of all collected samples in Priority Zone II have Zinc concentration below background level.

The five (5) samples collected along North-West shoreline of Clark Island (Priority Zone I) have all Zinc concentrations above MENVIQ level 3 criterion. The measured Zinc values in this zone vary from 2 210 to 4 760 mg/kg.

## **Total Organic Carbon**

For samples SE-93-01 to SE-93-14, the percentage of Total Organic Carbon is around 6%. This is confirmed by field descriptions where these samples are characterized as organic silt of black colour. The other samples along Grande-Ile shoreline have an average percentage of Total Organic Carbon of 0.67%.



GRAPHIC SCALE / ÉCHELLE GRAPHIQUE

0 20 100m

# LEGEND / LÉGENDE :

ZINC CONCENTRATION ABOVE MENVQ LEVEL 3 CRITERION

- SE-9(124) SURFACE SEDIMENTS SAMPLING STATION / STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS DE SURFACE (JANUARY/JANVIER 1988)
- SE-90-13 SEDIMENTS BOREHOLE / FORAGE AU TRAVERS DES SÉDIMENTS (FEBRUARY/FÉVRIER 1990)
- SE-90-112 SURFACE SEDIMENTS SAMPLING STATION / STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS DE SURFACE (JUNE/JUIN 1990)

- SE-93-01 SURFACE SEDIMENTS SAMPLING STATION / STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS DE SURFACE (FEBRUARY/FÉVRIER 1993)
- SE-93-66 SAMPLING STATION WHERE NO SEDIMENTS WERE RECOVERED / STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS DE SURFACE SANS RÉCUPÉRATION (FEBRUARY/FÉVRIER 1993)

**Allied Signal**  
**ENGINEERED MATERIALS**

N° contrat/contract  
4361-1000

Échelle / Scale  
1:4000

Date  
APRIL 1993

**EXTENT OF SEDIMENTS  
CONTAMINATION ALONG  
GRANDE-ILE SHORELINE  
ZINC**

FIGURE : 8.5



Total Organic Carbon percentage for the five (5) samples collected along the North-West shoreline of Clark Island (Priority zone I) vary from 0.11 to 0.30%.

## **8.2            Quality Assurance and Quality Control Program**

An internal QA/QC program was implemented by ECO-CNFS laboratory where six (6) samples were tested in triplicate. The results are shown on Table 8.3 and indicate that the concentration values are in the same range.

An external QA/QC program was realized on six (6) samples by the Zenon laboratory. The duplicate samples are composed of the same materials. After the sample was collected, it was homogenized and split in the two duplicates and sent to two different laboratories. The results of this program are compiled on Table 8.4, and indicate that the concentration values are in the same range.

## **8.3            Sediments Characteristics Correlation**

### **8.3.1        Correlation between Grain Size and Total Zinc Concentration**

The correlation between the total Zinc concentration and the sediments grain size was analyzed in order to identify whether there is a relation between these two sediment characteristics. For metals, this comparison is limited to total Zinc concentration considering that Zinc is the most important contaminant found in the sediments along Grande-Ile shoreline. This correlation is illustrated in the semi-log plot of Figure 8.6.

Based on Figure 8.6, it could be confirmed that a relation exists between grain size and total Zinc concentration of the sediments. Indeed, the finer the sediment particles are the higher the Zinc concentrations are found. This

**TABLE 8.3**  
**ALLIED-SIGNAL INC. - CLARK ISLAND SITE**  
**GRANDE-ILE SHORELINE SEDIMENTS CHARACTERIZATION**  
**RESULTS OF THE INTERNAL QA/QC PROGRAM**  
**FROM ECO-CNFS LABORATORY**

SAMPLE NUMBER	TEST NUMBER	METALS CONCENTRATION (mg/kg) (1)				TOTAL ORGANIC CARBON (%)
		ARSENIC	CADMIUM	COPPER	ZINC	
SE-93-04	01	33.00	7.00	212.00	1 440.00	5.65
	02	34.00	6.00	210.00	1 460.00	5.63
	03	34.00	6.00	210.00	1 450.00	5.55
	AVERAGE	34.00	6.00	210.00	1 450.00	5.61
SE-93-27	01	50.00	3.84	65.00	4 110.00	0.50
	02	50.00	3.61	65.00	4 110.00	0.51
	03	54.00	3.88	67.00	4 180.00	0.48
	AVERAGE	51.00	3.78	66.00	4 133.00	0.50
SE-93-35	01	1.70	0.45	5.00	296.00	0.20
	02	1.80	0.48	6.00	321.00	0.20
	03	2.00	0.48	5.00	317.00	0.15
	AVERAGE	1.80	0.47	5.00	311.00	0.18
SE-93-55	01	1.00	0.70	6.00	141.00	0.28
	02	1.30	0.66	5.00	123.00	0.26
	03	0.60	0.68	5.00	125.00	0.22
	AVERAGE	1.00	0.68	5.00	130.00	0.25
SE-93-73	01	12.00	1.40	28.00	754.00	0.56
	02	13.00	1.50	28.00	767.00	0.49
	03	12.00	1.40	27.00	757.00	0.47
	AVERAGE	12.00	1.46	28.00	759.00	0.51
SE-93-85	01	127.00	19.00	1 110.00	4 660.00	0.17
	02	153.00	19.00	1 160.00	4 820.00	0.15
	03	128.00	21.00	1 150.00	4 810.00	0.18
	AVERAGE	136.00	20.00	1 140.00	4 760.00	0.17

(1) MERCURY IS ALWAYS TESTED BY THE ANALYTICAL LABORATORY IN DUPLICATE FOR EACH SAMPLE AND  
NO ADDITIONAL SPECIFIC INTERNAL QA/QC PROGRAM WAS CARRIED OUT

TABLE 8.4  
ALLIED-SIGNAL INC. - CLARK ISLAND SITE  
GRANDE-ILE SHORELINE SEDIMENTS CHARACTERIZATION  
RESULTS OF THE EXTERNAL QA/QC PROGRAM  
ECO-CNFS AND ZENON LABORATORIES

SAMPLE NUMBER	LABORATORY (1)	METALS CONCENTRATION (mg/kg)					TOTAL ORGANIC CARBON (%)
		ARSENIC	CADMIUM	COPPER	MERCURY	ZINC	
SE-93-45	EC	12.00	1.89	35.00	0.59	1 470.00	0.64
	ZE	4.50	1.60	32.00	0.18	1 300.00	0.48
SE-93-58	EC	0.90	1.01	4.00	<0.02	168.00	0.08
	ZE	<0.50	0.95	7.80	<0.02	170.00	0.15
SE-93-61	EC	1.70	1.15	6.00	<0.02	194.00	0.32
	ZE	0.90	0.93	6.30	0.028	160.00	0.08
SE-93-62	EC	2.20	1.51	16.00	0.13	364.00	0.58
	ZE	1.40	1.40	20.00	0.12	330.00	0.41
SE-93-75A	EC	4.00	4.04	36.00	0.54	488.00	1.79
	ZE	4.50	4.40	38.00	0.41	450.00	1.80
SE-93-81	EC	86.00	18.00	1160.00	50.00	3010.00	0.21
	ZE	78.20	16.00	1 100.00	46.00	2500.00	0.35

(1) EC = ECO-CNFS LABORATORY  
ZE = ZENON LABORATORY

GRANDE-ILE SEDIMENT CHARACTERIZATION  
CORRELATION BETWEEN SEDIMENTS GRAIN-SIZE AND TOTAL ZINC CONCENTRATION

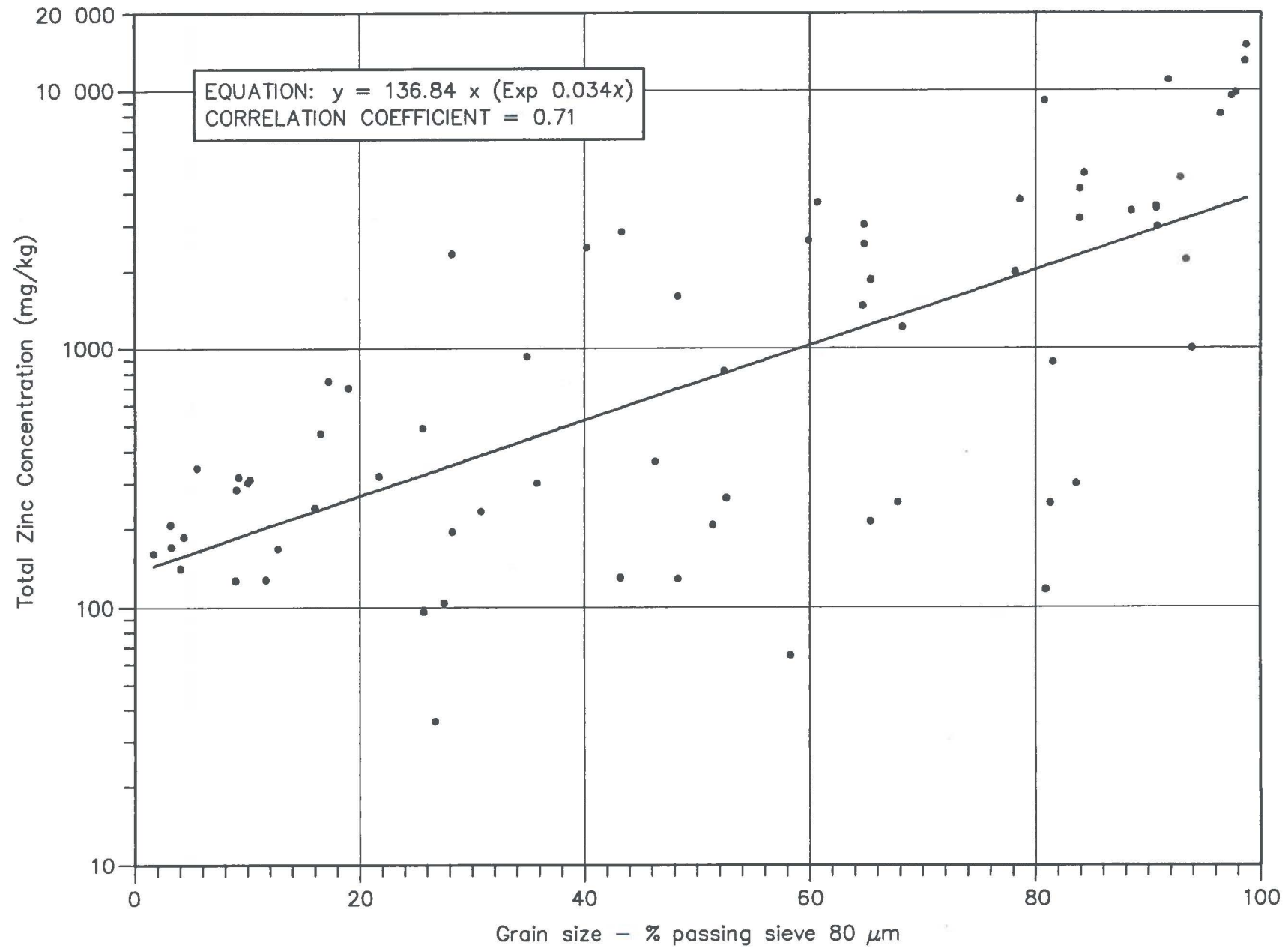


FIGURE 8.6



confirms the fact that the contaminants bind more easily to fine particles than to coarse particles.

### **8.3.2      Correlation between Total Organic Carbon and Total Zinc Concentration**

The correlation between the total Zinc concentration and the Total Organic Carbon of the sediments was also analyzed to identify whether there is a relation between these two sediment characteristics. As explained above, only total Zinc concentration was retained for the comparison. The linear correlation is illustrated on Figure 8.7.

Based on the data shown in this Figure, it can be observed that a relation exists between Total Organic Carbon and total Zinc concentration in sediments. An increase of Total Organic Carbon translates into an increase of the total Zinc concentration. This correlation demonstrates that the contaminants bind more easily to the organic fraction of the sediment particles.

## **9.0      LATERAL EXTENT AND VOLUME OF CONTAMINATED SEDIMENTS IN PRIORITY ZONE II**

### **9.1      River Bathymetry along Grande-Ile Shoreline**

Information concerning the bathymetry of the river bottom was obtained at each sediment sampling station as illustrated in Figure 2.1 and in Table 6.1. From this information, the extent of Priority Zone II was more precisely defined.

GRANDE-ILE SEDIMENT CHARACTERIZATION  
CORRELATION BETWEEN TOTAL ORGANIC CARBON AND TOTAL ZINC CONCENTRATION

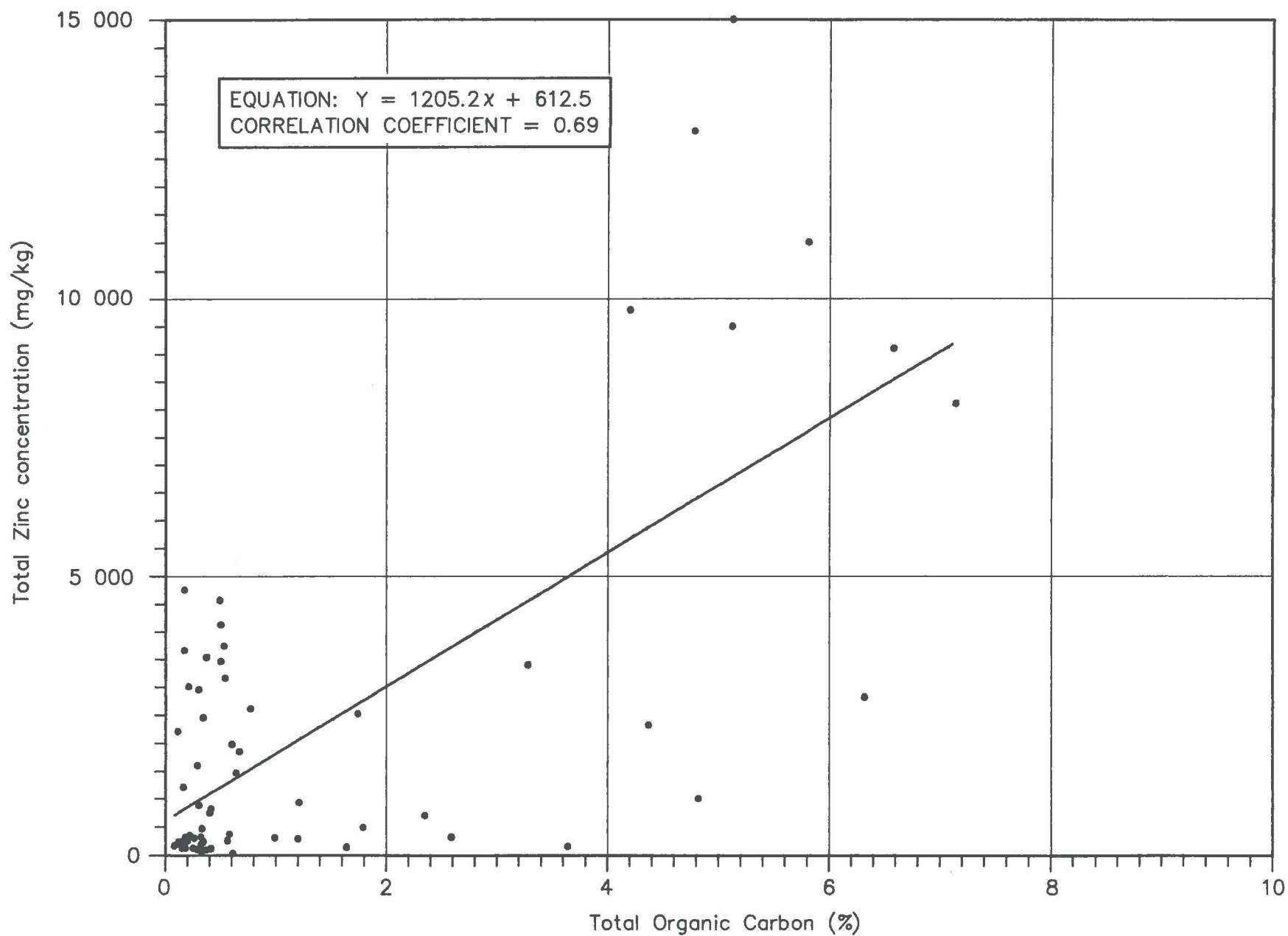


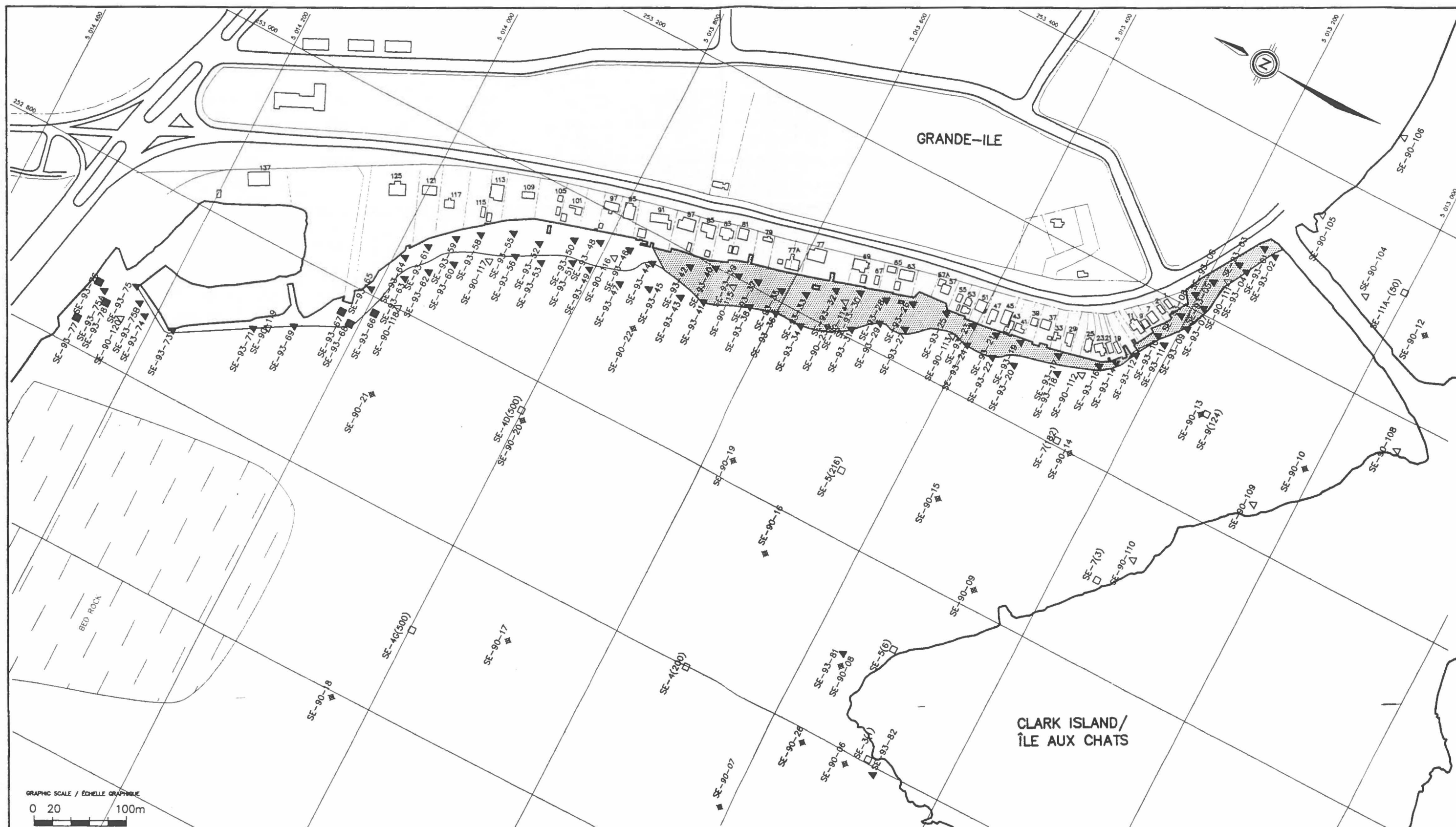
FIGURE 8.7

## **9.2            Contaminated Sediments Extent and Volume along Grande-Ile Shoreline**

The data available for the river sediment characterization includes the 1990 and the 1993 sampling programs. The information was compiled in order to define the lateral extent of contaminated sediments. The contaminated area is the one where at least one compound was found in excess of the level 3 criterion of the MENVIQ guidelines. At certain locations, where a small non contaminated area is surrounded by a contaminated zone, the area is also considered contaminated for practical purposes. It should be noted that sample SE-90-116 was found contaminated by Zinc in 1990. However, all samples collected around this sample in 1993 were found not contaminated. Thus, this sample was no longer considered in the contaminated sediments extent interpretation.

The contaminated area along Grande-Ile shoreline is illustrated in Figure 9.1 and represents a total surface of 21 480 m<sup>2</sup>. The total length of this contamination from Clark Island causeway downstream is approximately 750 m. The area width from the shoreline varies from 8 m to 56 m.

According to the findings of the characterization campaign, the vertical extent of sediments is relatively thin. At many stations, a layer of clay under the surface sediment layer was observed. It is not possible to specify at this time the exact thickness of the sediments layer, but it is most likely less than 0.5 meter. In order to evaluate the volume of contaminated sediments in Priority Zone II, a conservative thickness value of 0.5 meters was used. Thus, the volume of contaminated sediments along Grande-Ile shoreline is in the order of 10 740 m<sup>3</sup>. If restoration works are envisaged, deeper samples will have to be collected in this zone to better estimate the volume of contaminated sediments to be dredged.



GRAPHIC SCALE / ÉCHELLE GRAPHIQUE

0 20 100m

LEGEND/LÉGENDE :

- SE-9(124) □ SURFACE SEDIMENTS SAMPLING STATION/  
STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS  
DE SURFACE (JANUARY/JANVIER 1988)
- SE-90-13 ⊕ SEDIMENTS BOREHOLE/  
FORAGE AU TRAVERS DES SÉDIMENTS  
(FEBRUARY/FÉVRIER 1990)
- SE-90-112 △ SURFACE SEDIMENTS SAMPLING STATION/  
STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS  
DE SURFACE (JUNE/JUIN 1990)

- SE-93-01 ▲ SURFACE SEDIMENTS SAMPLING STATION/  
STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS  
DE SURFACE (FEBRUARY/FÉVRIER 1993)
- SE-93-66 ■ SAMPLING STATION WHERE NO SEDIMENTS  
WERE RECOVERED / STATION D'ÉCHANTIL-  
LONNAGE DES SÉDIMENT DE SURFACE SANS  
RÉCUPÉRATION (FEBRUARY/FÉVRIER 1993)



N° contrat/contract  
4361-1000

Échelle / Scale  
1:4000

Date  
APRIL 1993

EXTENT OF SEDIMENTS  
CONTAMINATION ALONG  
GRANDE-ILE SHORELINE

FIGURE : 9.1



## 10.0 UPDATED RISKS CALCULATION

The health risks for residents or recreational users associated with wading in the river water and floundering in the sediments along Grande-Ile shoreline have been calculated in the Phase III report. These risks have been updated using the 1993 data. Exposure conditions and risk indicators have been considered the same.

It was noted during this characterization campaign, after discussions with riverside residents, that people frequently swim in the river water along the Grande-Ile shoreline during the summer season.

According to the new data, thirty-six (36) 1993 sampling stations are shallower than 1.5 m and were considered in the risk calculations.

Table 10.1 presents the updated exposure concentration of indicator chemicals in nearshore sediments along Grande-Ile shoreline.

According to the exposure concentrations, the daily intakes by dermal contact for each indicator chemicals have been updated as shown on Table 10.2.

Carcinogenic risks associated with the exposure to Grande-Ile shoreline nearshore sediments have been updated in Table 10.3. They correspond to a value of  $3.45 \times 10^{-7}$ .

Hazard indexes associated with the exposure to nearshore sediments along Grande-Ile shoreline have been updated in Table 10.4. They correspond to a value of 0.071.

**TABLE 10.1**  
**ALLIED-SIGNAL INC. – CLARK ISLAND SITE**  
**GRANDE-ILE SHORELINE SEDIMENTS CHARACTERIZATION**  
**INDICATOR CHEMICAL CONCENTRATIONS IN SEDIMENTS**

INDICATOR CHEMICAL	EXPOSURE CONCENTRATION (C <sub>se</sub> )(1) (mg/kg)	
	From 1990 results	From 1993 results
ARSENIC	5.2	4.87
CADMIUM	4.6	2.08
COPPER	26.9	23.85
MERCURY	0.29	0.163
LEAD	21.4	21.4 (2)
SELENIUM	3.5	3.5 (2)
ZINC	1152.8	670.6

(1) GEOMETRIC MEANS ARE CALCULATED USING 1/2 THE DETECTION LIMIT FOR VALUES BELOW THE DETECTION LIMIT

(2) USING 1990 SAMPLES RESULTS BECAUSE NO LEAD AND SELENIUM TESTS WERE CARRIED OUT IN 1993

**TABLE 10.2**  
**ALLIED-SIGNAL INC. – CLARK ISLAND SITE**  
**GRANDE-ILE SHORELINE SEDIMENTS CHARACTERIZATION**  
**EXPOSURE INTAKES – DERMAL CONTACT WITH SURFACE SEDIMENTS (1)**

INDICATOR CHEMICAL	DDI <sub>se</sub>	SA	CA <sub>se</sub>	DAF	CF
ARSENIC	1.05E-05	3.35E+03	1.50E+00	3.00E-02	1.00E-06
CADMIUM	4.48E-06	3.35E+03	1.50E+00	3.00E-02	1.00E-06
COPPER	1.71E-05	3.35E+03	1.50E+00	1.00E-02	1.00E-06
MERCURY	5.85E-07	3.35E+03	1.50E+00	5.00E-02	1.00E-06
LEAD	1.54E-05	3.35E+03	1.50E+00	1.00E-02	1.00E-06
SELENIUM	2.51E-06	3.35E+03	1.50E+00	1.00E-02	1.00E-06
ZINC	4.81E-04	3.35E+03	1.50E+00	1.00E-02	1.00E-06

DDI<sub>se</sub> = ABSORBED DAILY DERMAL INTAKE (mg/kg/day)

SA = EXPOSED SKIN SURFACE AREA (cm<sup>2</sup>)

CA<sub>se</sub> = SURFACE SEDIMENTS CONTACT AMOUNT (mg/cm<sup>2</sup>)

DAF = DERMAL ABSORPTION FACTOR (% EXPOSURE)

CF = CONVERSION FACTOR (kg surface sediment/mg surface sediment)

DDI<sub>se</sub> = C<sub>se</sub> x SA x CA<sub>se</sub> x DAF x CF / 70

(1) USING 1993 SAMPLES RESULTS ONLY

**TABLE 10.3**  
**ALLIED-SIGNAL INC. – CLARK ISLAND SITE**  
**GRANDE-ILE SHORELINE SEDIMENTS CHARACTERIZATION**  
**CANCINOGENIC RISK – DERMAL CONTACT WITH SURFACE SEDIMENTS**

INDICATOR CHEMICAL	DD <sub>se</sub>	PF	F(c)	RISK
ARSENIC	1.05E-05	1.75E+00	1.88E-02	3.45E-07
CADMIUM	4.48E-06	NA	1.88E-02	0.00E+00
COPPER	1.71E-05	NA	1.88E-02	0.00E+00
MERCURY	5.85E-07	NA	1.88E-02	0.00E+00
LEAD	1.54E-05	NA	1.88E-02	0.00E+00
SELENIUM	2.51E-06	NA	1.88E-02	0.00E+00
ZINC	4.81E-04	NA	1.88E-02	0.00E+00
<b>TOTAL</b>				<b>3.46E-07 (1)</b>

DD<sub>se</sub> = ABSORBED DAILY DERMAL INTAKE (mg/kg/day)

PF = CANCINOGENIC POTENCY FACTOR (1/mg/kg/day)

F (c) = EXPOSURE FRACTION OVER A LIFETIME OF 70 YEARS x 52 WEEKS x 7 DAYS

NA = CHEMICAL IS NOT A CARCINOGEN

RISK = F(c) x DD<sub>se</sub> x PF

(1) FROM 1990 SAMPLE RESULTS, THE CALCULATED RISK WAS 3.68E-07



**TABLE 10.4**  
**ALLIED-SIGNAL INC. – CLARK ISLAND SITE**  
**GRANDE-ILE SHORELINE SEDIMENTS CHARACTERIZATION**  
**NONCARCINOGENIC HAZARD**  
**DERMAL CONTACT WITH SURFACE SEDIMENTS**

INDICATOR CHEMICAL	DD <sub>se</sub>	RFD	HI
ARSENIC	1.05E-05	1.40E-03	7.50E-03
CADMIUM	4.48E-06	1.40E-04	3.20E-02
COPPER	1.71E-05	3.70E-02	4.62E-04
MERCURY	5.85E-07	2.00E-03	2.93E-04
LEAD	1.54E-05	5.70E-04	2.70E-02
SELENIUM	2.51E-06	3.00E-03	8.37E-04
ZINC	4.81E-04	2.10E-01	2.29E-03
<b>TOTAL</b>			<b>7.04E-02 (1)</b>

DD<sub>se</sub> = ABSORBED DAILY DERMAL INTAKE (mg/kg/day)

RFD = REFERENCE DOSE FOR CHRONIC EXPOSURE (mg/kg/day)

HI = DD<sub>se</sub> / RFD

(1) FROM 1990 SAMPLE RESULTS, THE CALCULATED HAZARD INDEX WAS 0.112

The updated risk values are compared with the original ones as follows :

	<b>Risks</b>	<b>Hazard Indexes</b>
Original (1990)	$3.68 \times 10^{-7}$	0.112
Updated (1993)	$3.45 \times 10^{-7}$	0.071

The updated risk values are not significantly different from the original values. They are in both cases lower than the original (1990) values.

## **11.0      SUMMARY AND CONCLUSIONS**

A preliminary characterization of river sediments along Grande-Ile shoreline was carried out during Phase III study in 1990. The data obtained showed that a significant area of the river bottom is covered by sediments with heavy metals concentrations.

During their review of the Phase III data, MENVIQ concluded that there are four (4) priority contaminated sediments zones around Clark Island. Grande-Ile shoreline was categorized as Priority Zone II. The lateral extent of these zones was based on the draft sediments criteria developed by the Ontario Ministry.

In April 1992, MENVIQ published their new sediment quality criteria. Based on Phase III characterization and on these new guidelines, the lateral extent of each Priority Zones was redefined. For Priority Zone II, it was decided to proceed with an additional sediment characterization considering that not enough

data (11 samples) were available to clearly define the contaminated sediments area.

The additional data will also provide information that will be useful in the AlliedSignal decision making process and will help if further sampling is required for the determination of sediments toxicity.

The 1993 characterization work included the sampling of seventy-three (73) surface sediments, of which sixty-eight (68) samples were collected along Grande-Ile shoreline (Priority Zone II) and five (5) samples were taken along the North-West shoreline of Clark Island (Priority Zone I). All samples were tested for five (5) heavy metals and for Total Organic Carbon content. Most of the samples were submitted to geotechnical tests to determine their grain size.

Based on MENVIQ guidelines, the sediments in Priority Zone II have, for some areas, elevated Arsenic, Cadmium, Copper, Mercury and Zinc concentrations. The main contaminant is Zinc and it is the one who controls the lateral extent of contamination in Priority Zone II.

The total area of contaminated sediments in Priority Zone II is 21 480 m<sup>2</sup>. The corresponding volume, based on a sediment depth of 0.5 meter, is 10 740 m<sup>3</sup>.

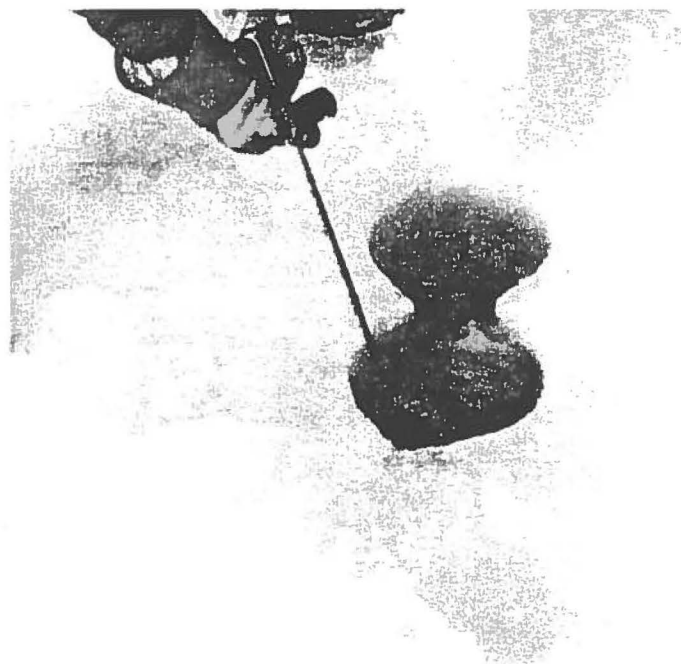
The risks associated with dermal contact with Grande-Ile shoreline sediments for local residents were updated using 1993 data. The updated risk values are below the values calculated for the 1990 data and are well within the range of acceptable values.

**APPENDIX A**  
**PHOTOGRAPHIES**





GRANDE-ILE SHORELINE SEDIMENTS CHARACTERIZATION  
DRILLING OF A HOLE THROUGH THE ICE COVER



GRANDE-ILE SHORELINE SEDIMENTS CHARACTERIZATION  
HOLE THROUGH THE ICE COVER

GRANDE-ILE SHORELINE SEDIMENTS  
CHARACTERIZATION  
WATER DEPTH MEASUREMENT



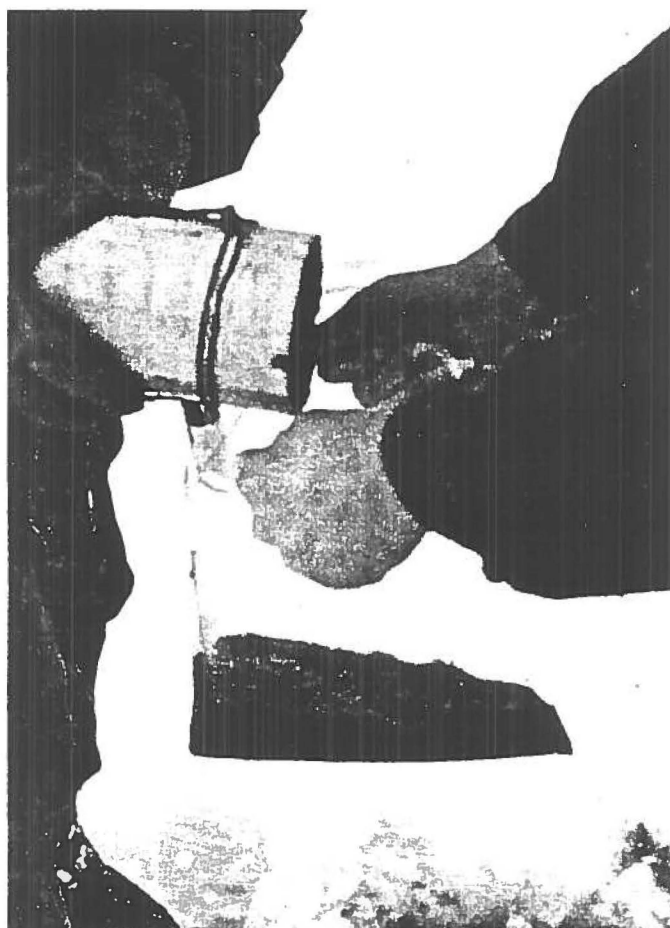
GRANDE-ILE SHORELINE SEDIMENTS  
CHARACTERIZATION  
TECSULT SAMPLER



GRANDE-ILE SHORELINE SEDIMENTS  
CHARACTERIZATION  
SEDIMENTS SAMPLING WITH THE  
TECSULT SAMPLER



GRANDE-ILE SHORELINE SEDIMENTS CHARACTERIZATION  
SEDIMENTS SAMPLE FROM STATION SE-93-81 LOCATED AT  
THE NORTHERN TIP OF CLARK ISLAND



GRANDE-ILE SHORELINE SEDIMENTS  
CHARACTERIZATION  
SAMPLE COLLECTION FOR  
GEOTECHNICAL TESTS



**APPENDIX B**  
**GRAIN-SIZE DISTRIBUTION CURVES**





## Grain-size distribution curve

PROJECT : ALLIED-SIGNAL INC.

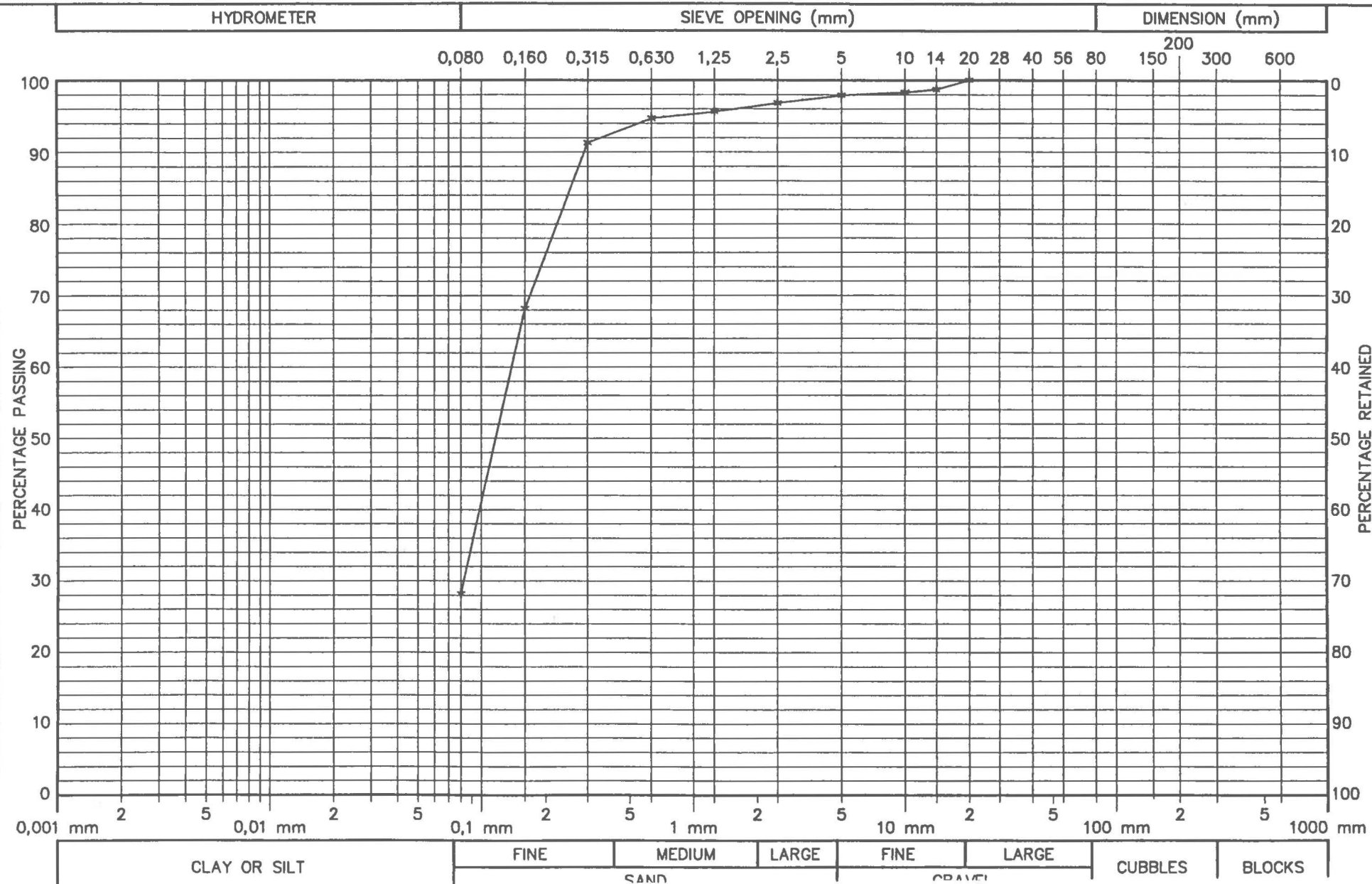
CONTRACT No : 4361-1000

LOCATION : GRANDE-ILE SHORELINE

SAMPLING POINT No :

SAMPLE No : SE-93-14

DATE : 1993-03-16





## Grain-size distribution curve

PROJECT : ALLIED-SIGNAL INC.

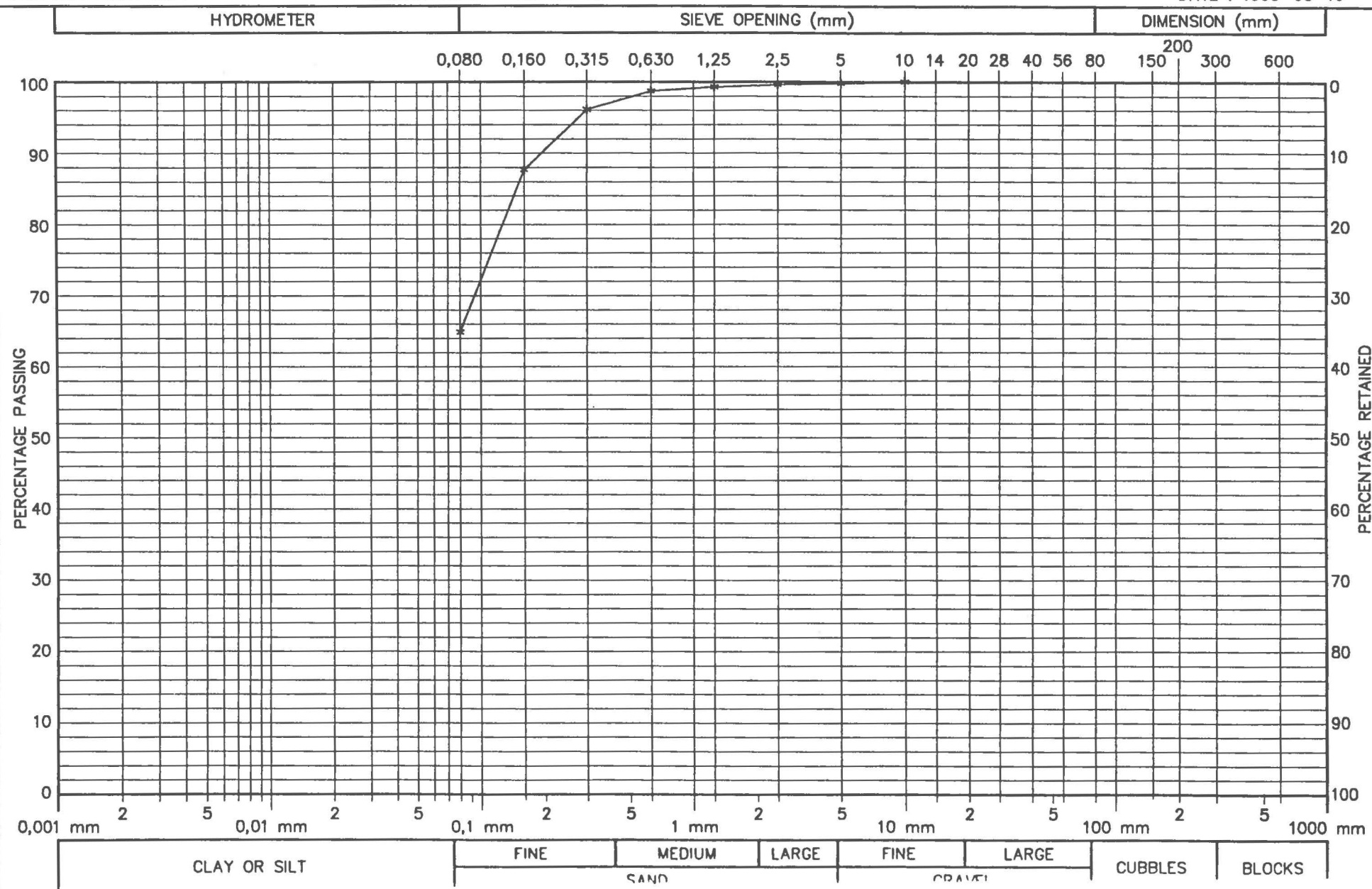
CONTRACT No : 4361-1000

LOCATION : GRANDE-ILE SHORELINE

SAMPLING POINT No :

SAMPLE No : SE-93-18

DATE : 1993-03-16







## Grain-size distribution curve

PROJECT : ALLIED-SIGNAL INC.

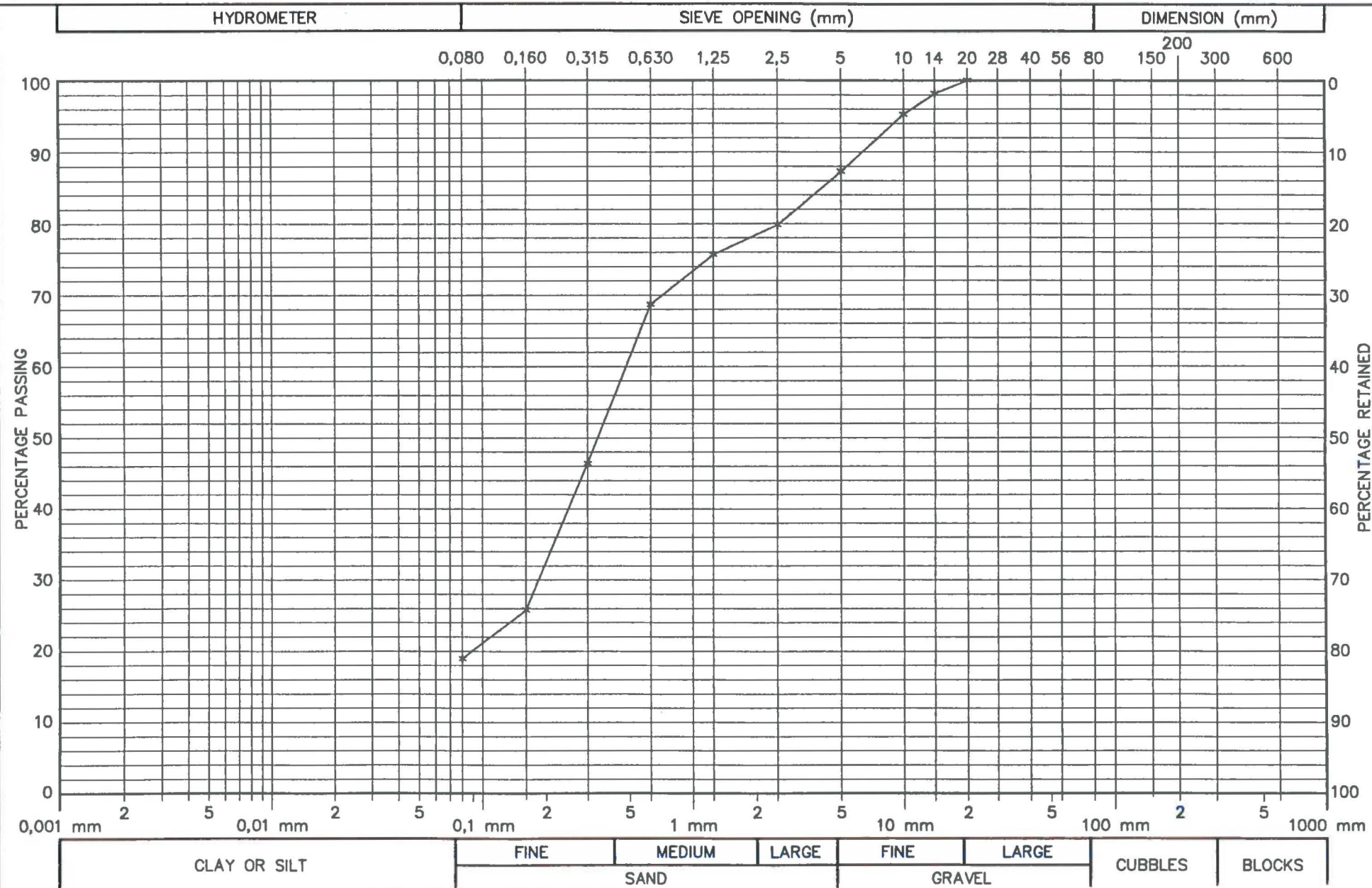
CONTRACT No : 4361-1000

LOCATION : GRANDE-ILE SHORELINE

SAMPLING POINT No :

SAMPLE No : SE-93-23

DATE : 1993-03-16





## Grain-size distribution curve

PROJECT : ALLIED-SIGNAL INC.

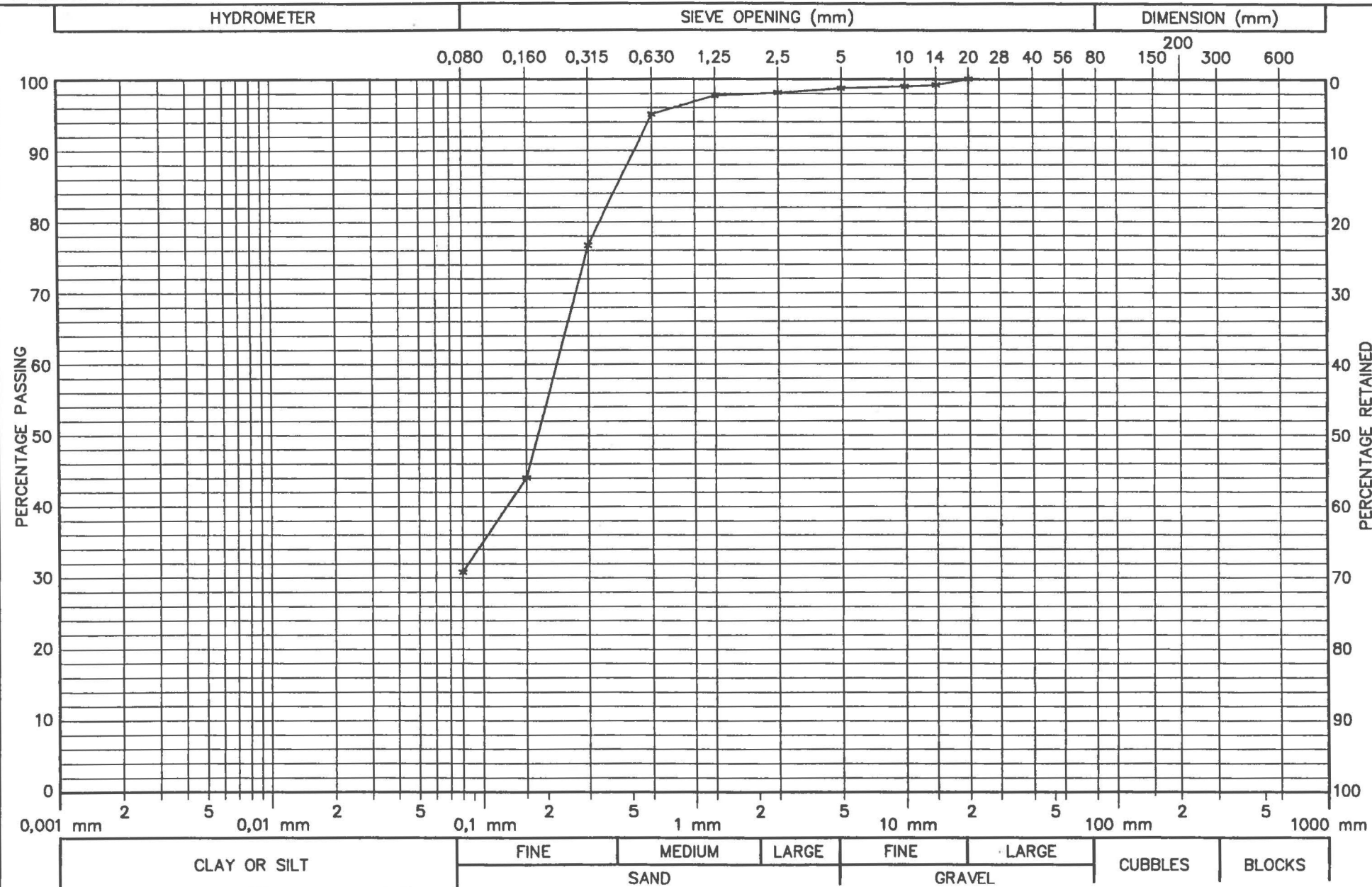
CONTRACT No : 4361-1000

LOCATION : GRANDE-ILE SHORELINE

SAMPLING POINT No :

SAMPLE No : SE-93-32

DATE : 1993-03-16





## Grain-size distribution curve

PROJECT : ALLIED-SIGNAL INC.

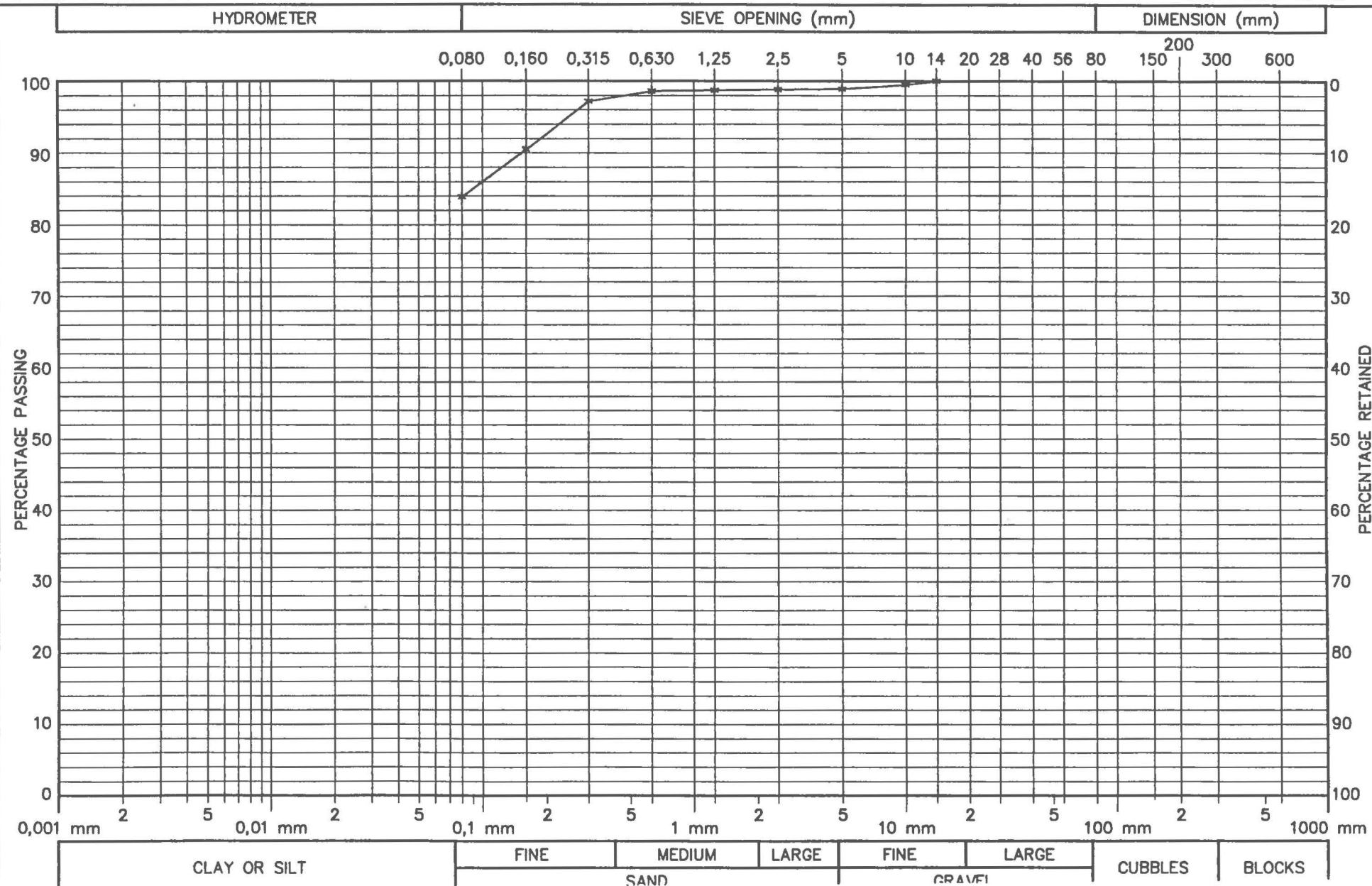
CONTRACT No : 4361-1000

LOCATION : GRANDE-ILE SHORELINE

SAMPLING POINT No :

SAMPLE No : SE-93-38

DATE : 1993-03-16





## Grain-size distribution curve

PROJECT : ALLIED-SIGNAL INC.

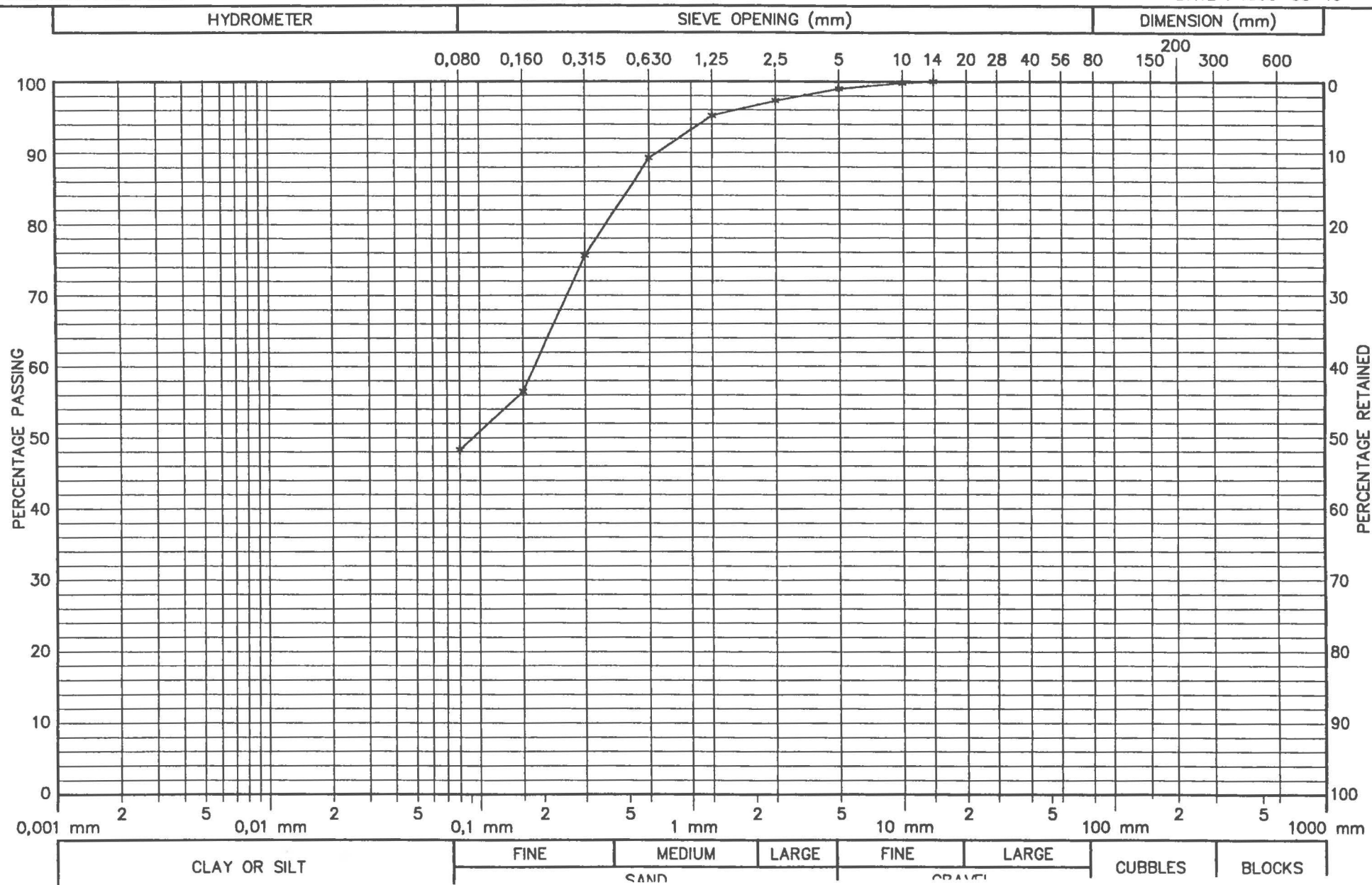
CONTRACT No : 4361-1000

LOCATION : GRANDE-ILE SHORELINE

SAMPLING POINT No :

SAMPLE No : SE-93-50

DATE : 1993-03-16







## Grain-size distribution curve

PROJECT : ALLIED-SIGNAL INC.

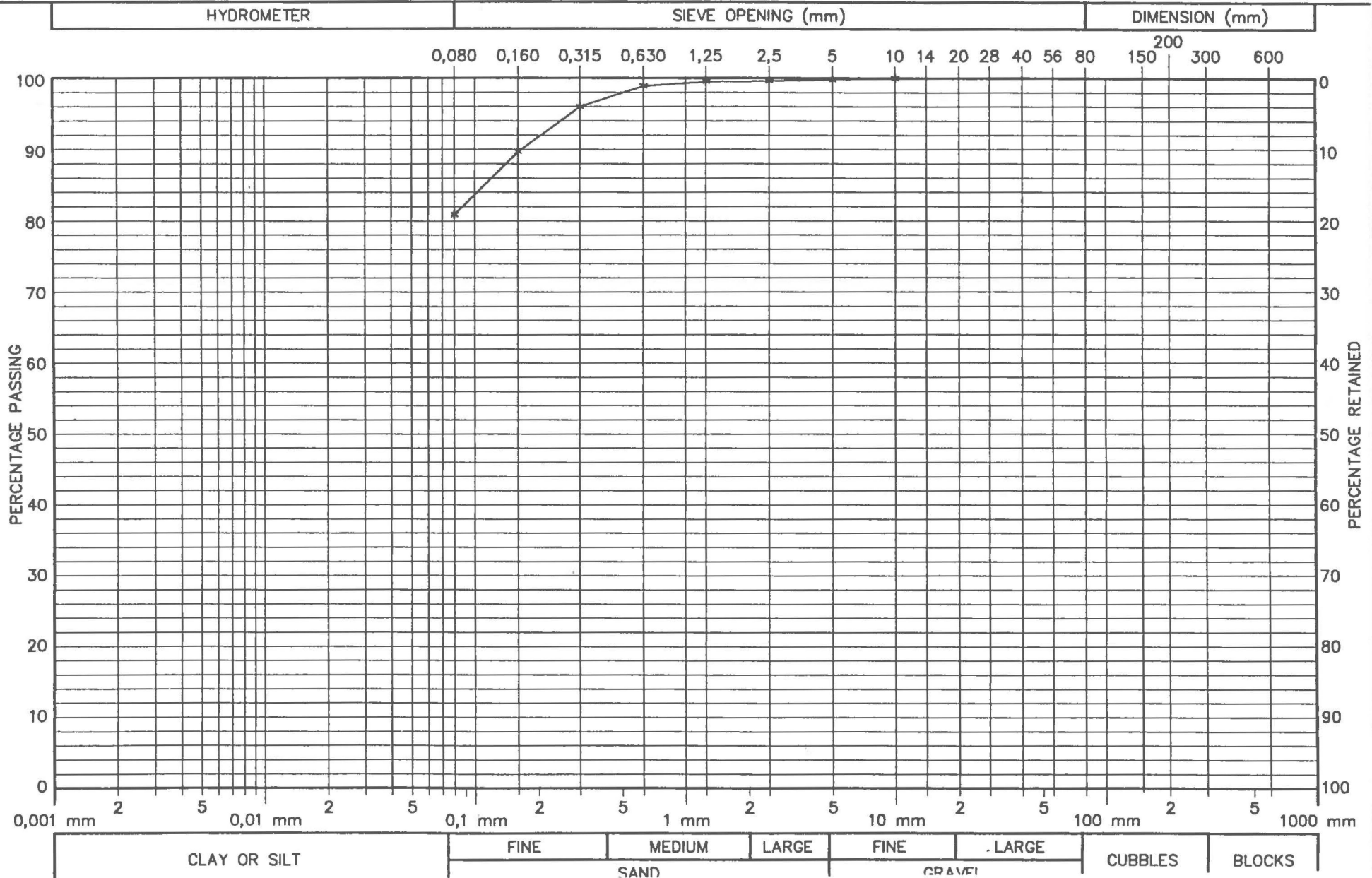
CONTRACT No : 4361-1000

LOCATION : GRANDE-ILE SHORELINE

SAMPLING POINT No :

SAMPLE No : SE-93-59

DATE : 1993-03-16





## Grain-size distribution curve

PROJECT : ALLIED-SIGNAL INC.

CONTRACT No : 4361-1000

LOCATION : GRANDE-ILE SHORELINE

SAMPLING POINT No :

SAMPLE No : SE-93-63

DATE : 1993-03-16





## Grain-size distribution curve

PROJECT : ALLIED-SIGNAL INC.

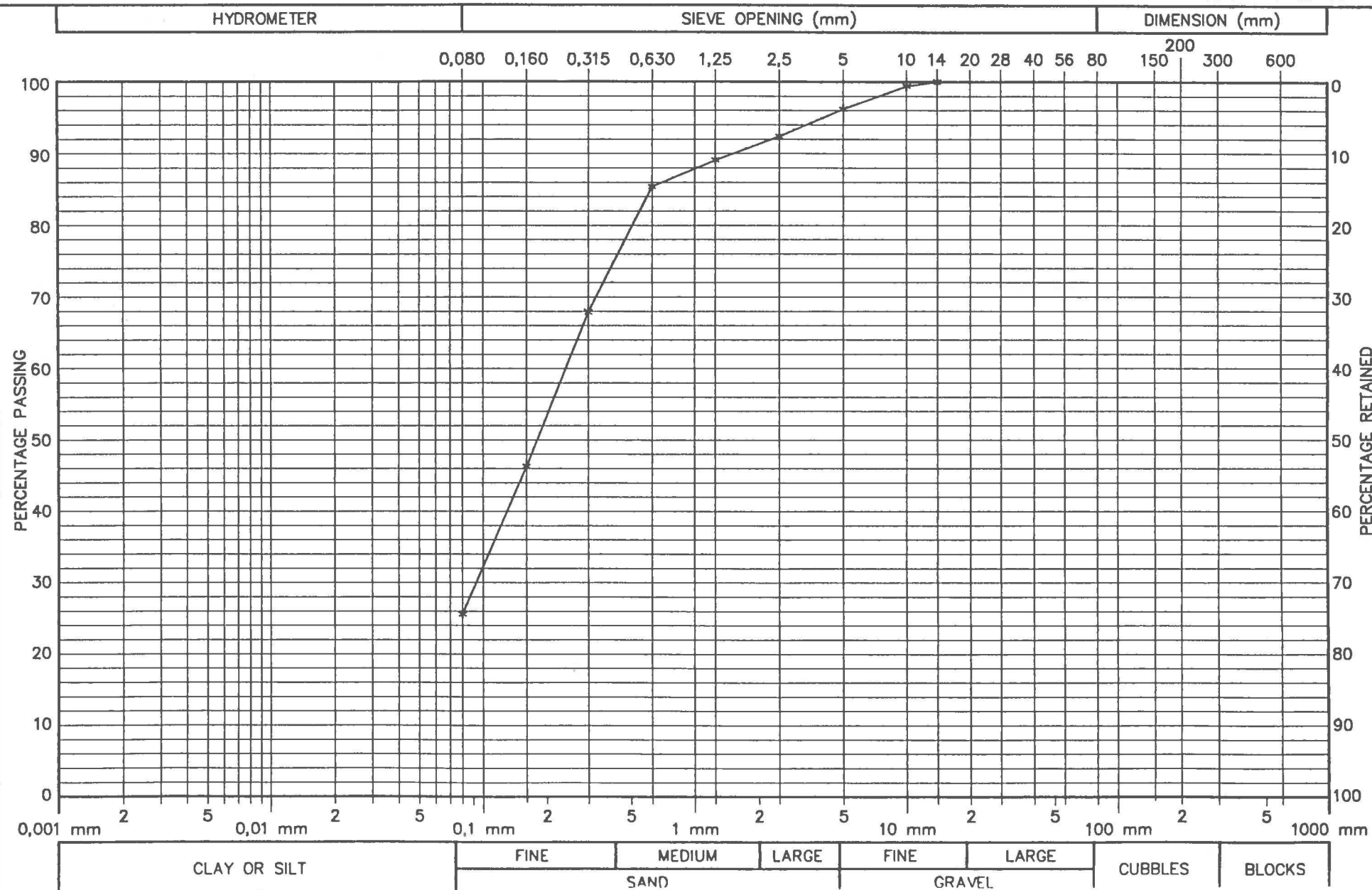
CONTRACT No : 4361-1000

LOCATION : GRANDE-ILE SHORELINE

SAMPLING POINT No :

SAMPLE No : SE-93-75A

DATE : 1993-03-16





## Grain-size distribution curve

PROJECT : ALLIED-SIGNAL INC.

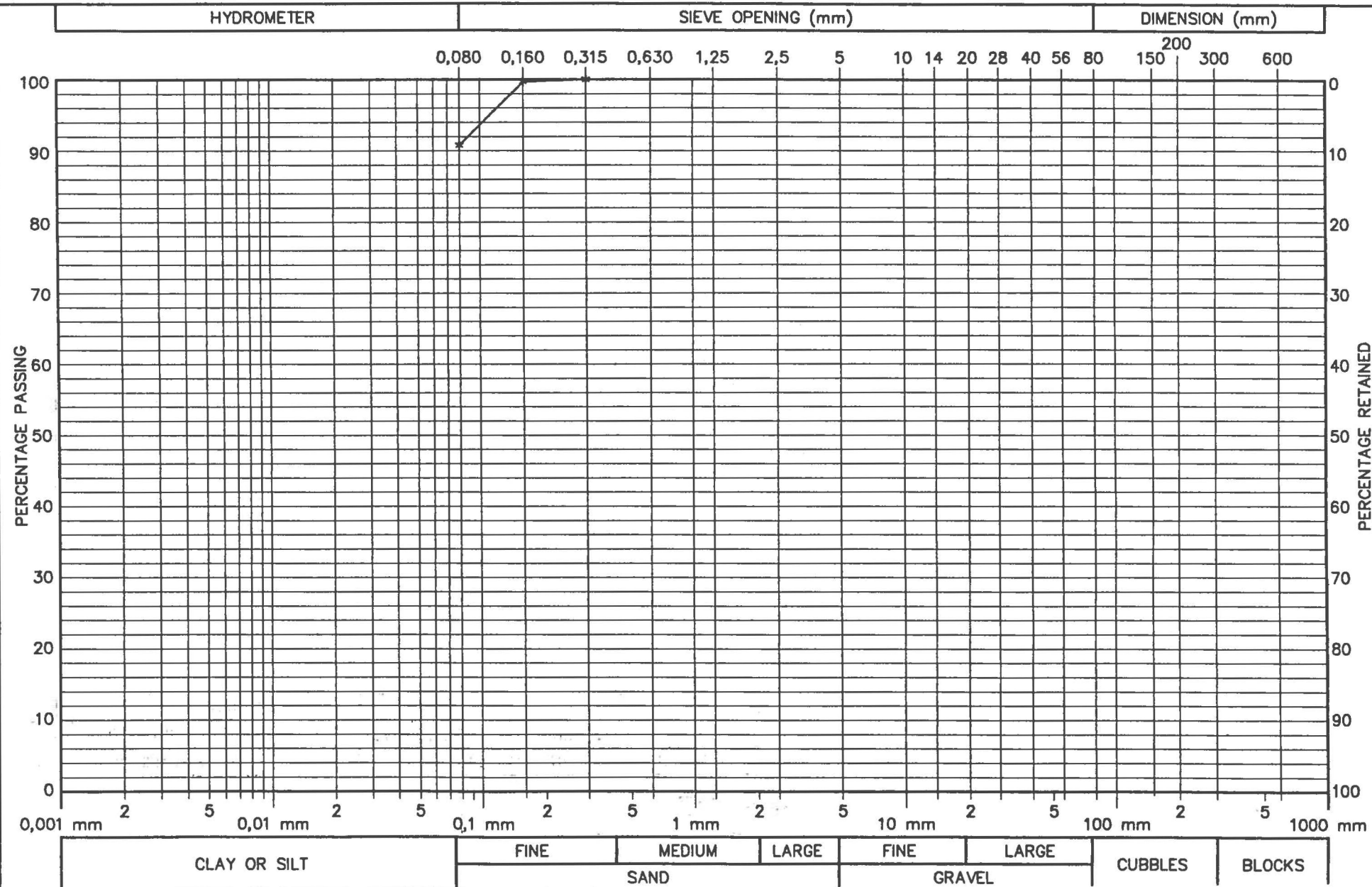
CONTRACT No : 4361-1000

LOCATION : GRANDE-ILE SHORELINE

SAMPLING POINT No :

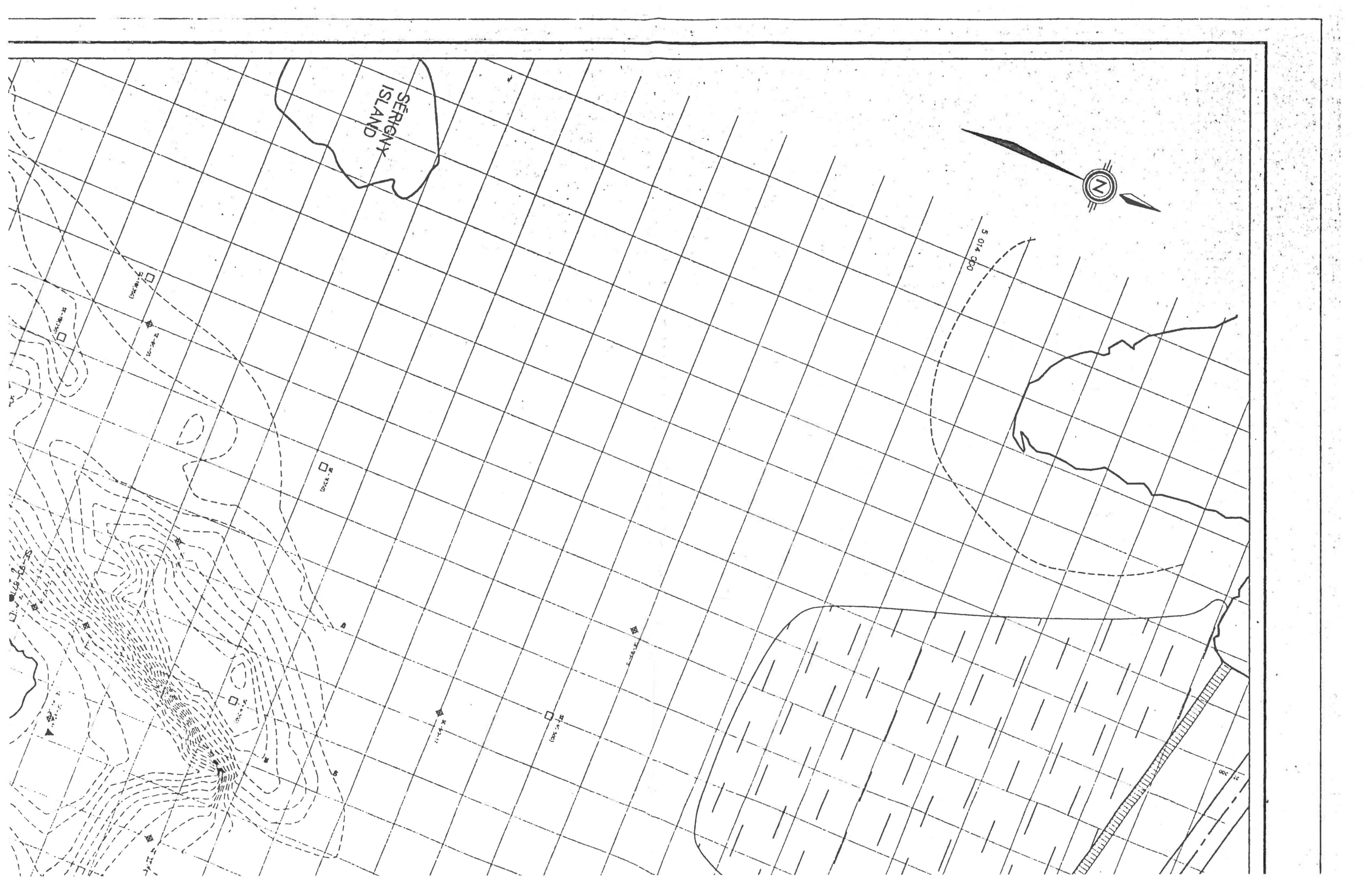
SAMPLE No : SE-93-83

DATE : 1993-03-16

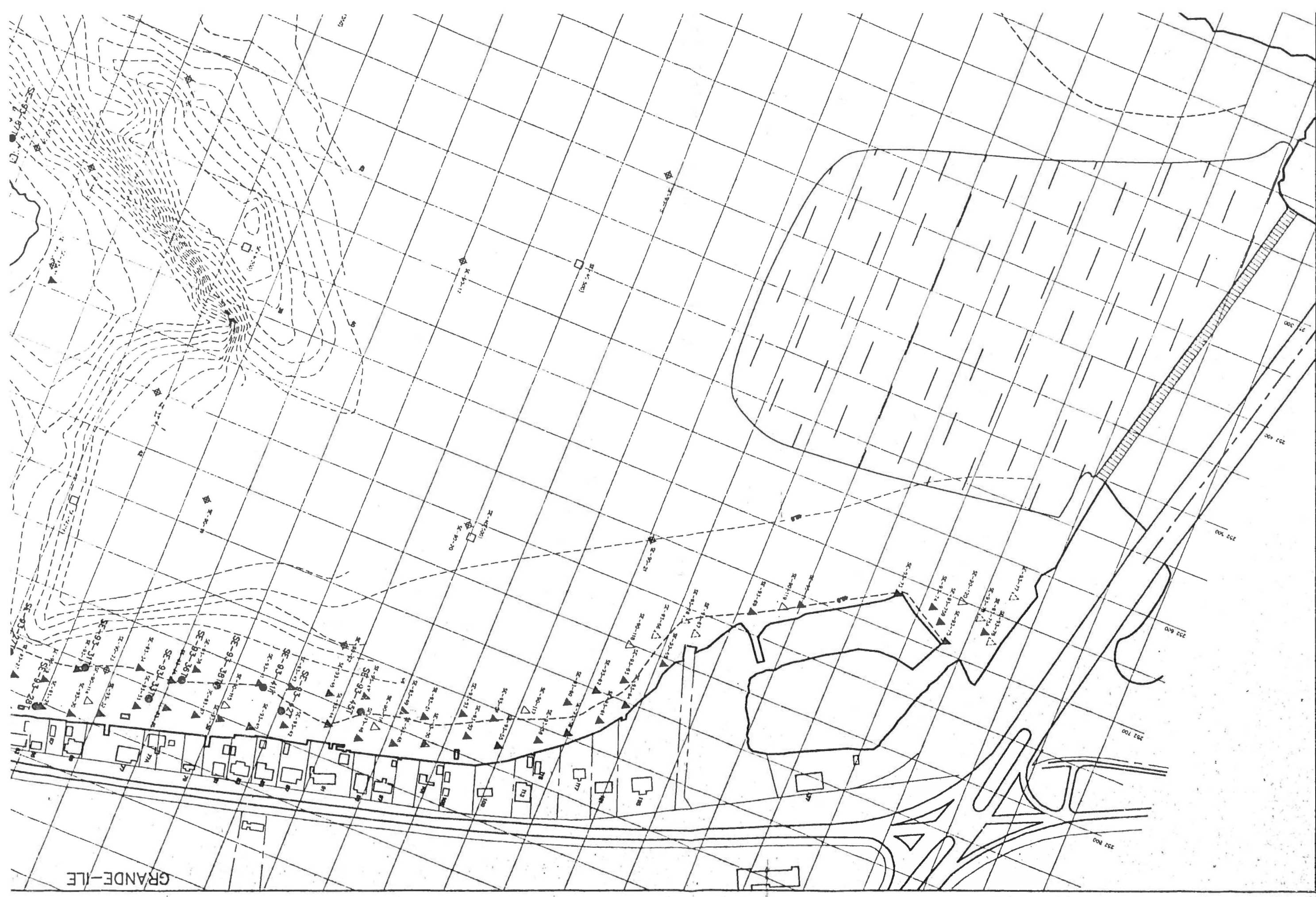


**APPENDIX C**  
**DRAWINGS**





GRANDE-ILE



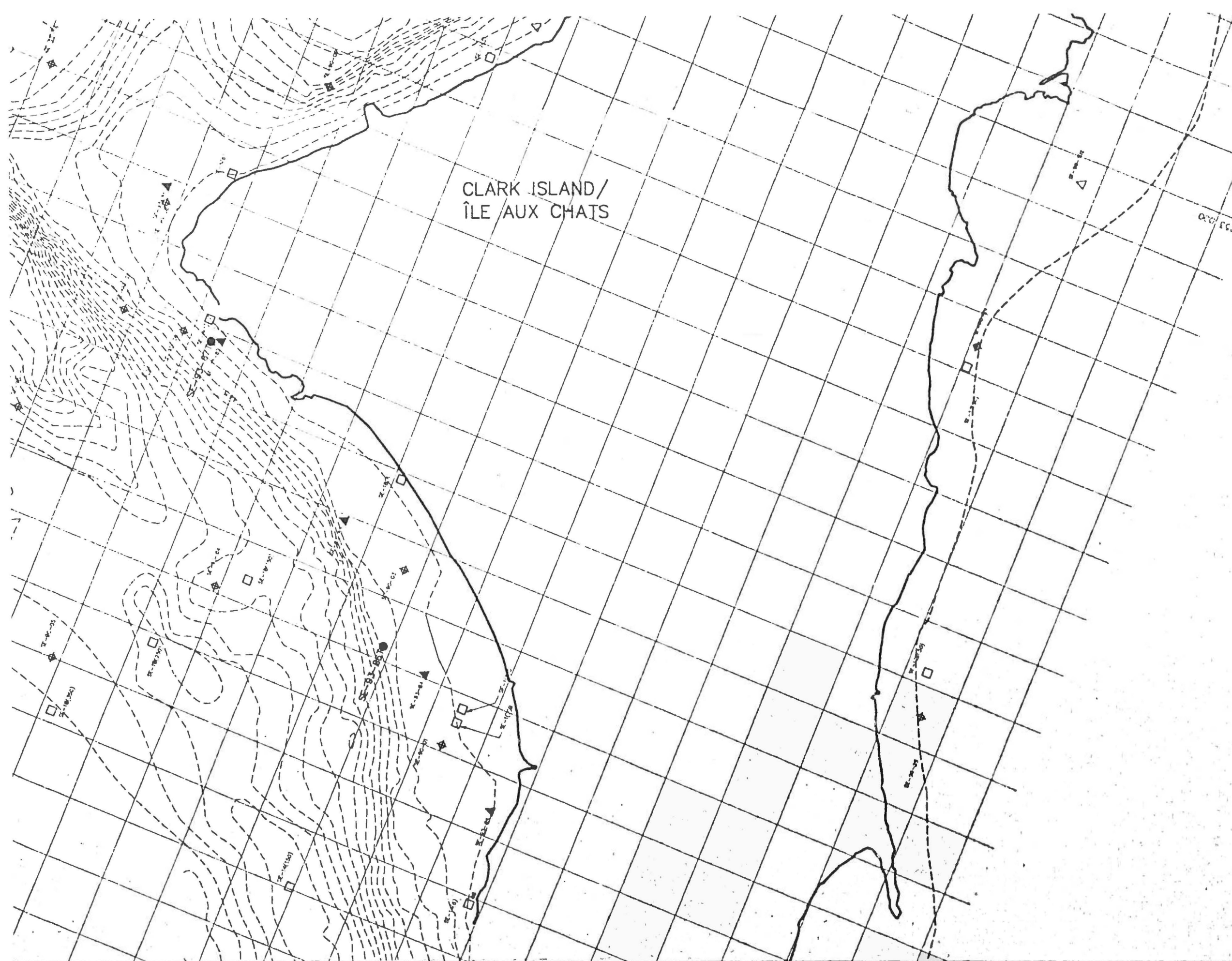


GRANDE-ÎLE

CLARK ISLAND/  
ÎLE AUX CHATS

LEGEND/LÉGENDE :

- SE-93-027 ● SURFACE SEDIMENTS SAMPLING STATION  
WITH TOXICITY TEST /  
STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS  
DE SURFACE AVEC ANALYSE DE TOXICITÉ  
(OCTOBER / OCTOBRE 1993)
- SE-9(124) □ SURFACE SEDIMENTS SAMPLING POINT/  
STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS



CLARK ISLAND/  
ÎLE AUX CHATS

LEGEND/LÉGENDE :

- SE-93-02T ● SURFACE SEDIMENTS SAMPLING STATION WITH TOXICITY TEST / STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS DE SURFACE AVEC ANALYSE DE TOXICITÉ (OCTOBER / OCTOBRE 1993)
- SE-9(124) □ SURFACE SEDIMENTS SAMPLING POINT / STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS DE SURFACE (JANUARY/JANVIER 1988)
- SE-90-13 ⊕ SEDIMENTS BOREHOLE / FORAGE AU TRAVERS DES SÉDIMENTS (FEBRUARY/FÉVRIER 1990)
- SE-90-112 △ SURFACE SEDIMENTS SAMPLING POINT / STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS DE SURFACE (JUNE/JUN 1990)
- SE-93-01 ▲ SURFACE SEDIMENTS SAMPLING POINT / STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS DE SURFACE (FEBRUARY/FÉVRIER 1993)
- SE-93-04 △ SURFACE SEDIMENTS SAMPLING POINT / STATION D'ÉCHANTILLONNAGE DES SÉDIMENTS DE SURFACE (FEBRUARY/FÉVRIER 1993)



NOUVEAU CHARTIERE / CHARTIERE NOUVEAU		
<p><b>SURFACE SEDIMENT SAMPLING STATION ALONG GRANDE-ÎLE SHORELINE</b></p>		
<p>Project No. / Numéro du projet : 4361</p>	<p>Client / Client : C.D. 2000</p>	<p>Scale / Échelle : 1:5000</p>
<p>Date / Date : DEC. 1993</p>	<p>Author / Auteur : 4361</p>	<p>Figure No. / Numéro de la figure : FIGURE 8.1</p>