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## MEMORANDUM

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TO: Dan Michielsen  
Province of Newfoundland & Labrador

REF. NO.: 058704-80

FROM: Luis Almeida/ca/13

DATE: December 2, 2009

CC: Robert Warren, WeirFoulds

RE: Residential Surficial Soil Sampling and Analyses, Town of Buchans (Town)

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Conestoga-Rovers & Associates (CRA) has prepared this memorandum to document the results of the October 12 to 15, 2009 residential surface soil sampling program. CRA completed the residential surface soil sampling at the request of the Province of Newfoundland & Labrador in order to more fully assess the impacts on the surface soil quality in residential and recreational areas of the Town of the deposition of metals-containing dusts from historic mining and waste disposal activities associated with the historic mining operations in Buchans.

CRA collected samples from the surface soil in residential areas within the Town and submitted the samples to the laboratory for analysis of the total concentration of metals and the bioavailability of the metals present in the samples. In this case, bioavailability refers to amount of metals present in the soil which are available for adsorption by the human body via digestion.

This memorandum transmits the total metals analytical data for the soil samples collected as part of this sampling program. CRA wishes to stress that no conclusions can be or should be drawn from these data until the bioavailability results have been received, reviewed and analysed by a CRA toxicologist as part of a Human Health Risk Assessment (Risk Assessment).

### SAMPLING PROGRAM SCOPE

CRA designed the surface soil sampling program to obtain data, which will be used to statistically represent and characterize the total and bioavailable metals concentrations in surface soils within the Town. This approach allows for the sampling of a portion of the properties in the Town and provides results that are generally representative of overall surface soil conditions. CRA notes that these results are specific to the areas that were sampled and are not characteristic of all surface soil metals concentrations on all properties. The data will be used to conduct a Risk Assessment, develop soil criteria which are more appropriate for use in evaluating Buchans surface soil metals data, and characterize risks, if any, related to human exposure to these soils.

CRA collected 41 residential surface soil samples and nine garden soil samples from 42 residential properties in the Town as shown on Figure 1<sup>1</sup>. The 41 samples were split such that 26 of the samples were collected from residential properties located in the vicinity of the Tailings Spill Area. CRA collected the remaining 15 samples from residential properties that are located some distance southwest of the Tailings Spill Area. CRA collected a background surface soil sample to establish a baseline.

CRA also collected nine surface soil samples from the public recreation areas in the town. These areas are shown on Figure 1 and included (sample description/sample identification):

- Tennis court ( SS-01)
- Parks ( SS-02 and SS-03)
- Baseball diamond (SS-04)
- Public swimming pool ( SS-05)
- Public library (SS-06)
- Children's playground ( SS-07)
- Mini-putt course ( SS-08)
- Hospital yard (SS-19)

The complete sample key is provided in Table 1.

CRA interviewed each landowner to obtain approval for the sampling and a brief history of their property and to determine the exterior areas of the property that are used most frequently by the residents. CRA also attempted to identify historical events and property developments, which may have potential effects on surficial soils (i.e., fires, import of fill or soils, spills/disposal of fireplace/wood burning stove ash etc.). Soil samples were collected as far away from residential structures (house, garage, shed), and historical events as possible to minimize any potential impacts. CRA then selected an area for composite samples that were representative of areas most used by the residents.

CRA collected composite surface soil samples using a pre-cleaned shovel or trowel. The soil was screened using a photoionization detector (PID) for organic vapours and based on visual (i.e., staining, discolouration, etc.), or olfactory evidence of impact. The samples were collected in a W pattern to provide a reasonable areal distribution of the individual samples in the area of interest. CRA then thoroughly mixed the individual samples in a stainless steel bowl to prepare the composite sample. CRA placed the composite soil samples in laboratory-supplied containers and delivered the samples under chain-of-custody protocols to the laboratory. CRA's contract laboratory, Maxxam Analytics, Inc. (Maxxam) completed the chemical analyses. Sampling equipment was decontaminated between soil sampling locations to ensure that metals impact from a previous sample didn't contaminate the next soil sample.

All samples collected were analysed for total metals. The samples are also being analysed for metals bioavailability. The bioavailability analyses will be provided in a separate memorandum as soon as CRA receives and reviews these results.

CRA compared the residential soil sample analytical results for metals to the CCME *Table 1 Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (Update 7.0, Updated September 2007)* for residential/parkland use.

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<sup>1</sup> A garden sample was collected from one residential property in lieu of a residential surface soil sample at the request of the resident.

SURFICIAL SOIL SAMPLING RESULTS

The complete analytical results are provided in Table 2. The following table presents a summary of the parameters, which were present in the samples at concentrations greater than the associated criteria. The associated criteria are based on conservative assumptions regarding the exposure that a person would have to the soil and the bioavailability of the metals in the soil. It should be noted that the CCME *Table 1 Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (Update 7.0, Updated September 2007)* for residential/parkland are generic standards, which are considered very protective to human health. CRA has used the CCME criteria as a data screening tool in this case as the CCME criteria generally over-estimate the risks associated with exposure to soils. The Risk Assessment will develop specific criteria for use in evaluating surface soil metals results for the Town.

Parameter	Criteria (mg/kg)	Number of Results Greater Than CCME Criterion	Minimum Result Greater Than Criterion (mg/kg)	Maximum Result Greater Than Criterion (mg/kg)
Arsenic	12	10	14	42
Barium	500	38	580	1,900
Cadmium	10	1	18	18
Copper	63	32	66	700
Lead	140	45	160	3,300
Selenium	1	4	2	3
Thallium	1	1	1.1	1.1
Zinc	200	40	230	5,100

Notes: CRA collected 50 surface soil samples from the locations shown on Figure 1.  
mg/kg - milligrams per kilogram

CRA collected nine garden soil samples ( SS-11G, SS-12G, SS-13G, SS-29G, SS-34G, SS-36G, SS-45G, SS-54G and SS-55G) as shown on Figure 1. Complete analytical results for total metals are provided in Table 2. The following table presents a summary of the total metals, which were present in the samples at concentrations greater than the associated criteria.

Parameter	Criteria (mg/kg)	Number of Results Greater Than CCME Criterion	Minimum Result Greater Than Criterion (mg/kg)	Maximum Result Greater Than Criterion (mg/kg)
Barium	500	2	710	910
Copper	63	2	76	120
Lead	140	2	320	540
Selenium	1	2	2	2
Zinc	200	3	210	480

Note: CRA collected Nine garden soil samples from the locations shown on Figure 1.

CRA notes that the laboratory reporting limit for selenium (i.e., the concentration below which the laboratory could not reliably detect the presence of selenium) was greater than the CCME criterion for this metal (reporting limit of 2 mg/kg versus a CCME criterion of 1 mg/kg). This creates some uncertainty with respect to interpreting the selenium data and selenium will be included in the Risk Assessment.

These results represent only a portion of the data required to conduct a Risk Assessment, develop specific soil screening criteria for surface soil in the Town and characterize risks related to human exposure to these soils. CRA is awaiting final bioavailability analyses and will provide a complete set of the data with the Risk Assessment Report. CRA will complete and finalize the Risk Assessment report within two months of the receipt of final bioavailability data.

**CRA wishes to stress that at this time no conclusions can be or should be drawn from these total metals data until the bioavailability analyses have been received, reviewed and assessed by a CRA toxicologist as part of a Risk Assessment.**

Should you have any questions on the above, please do not hesitate to contact us.

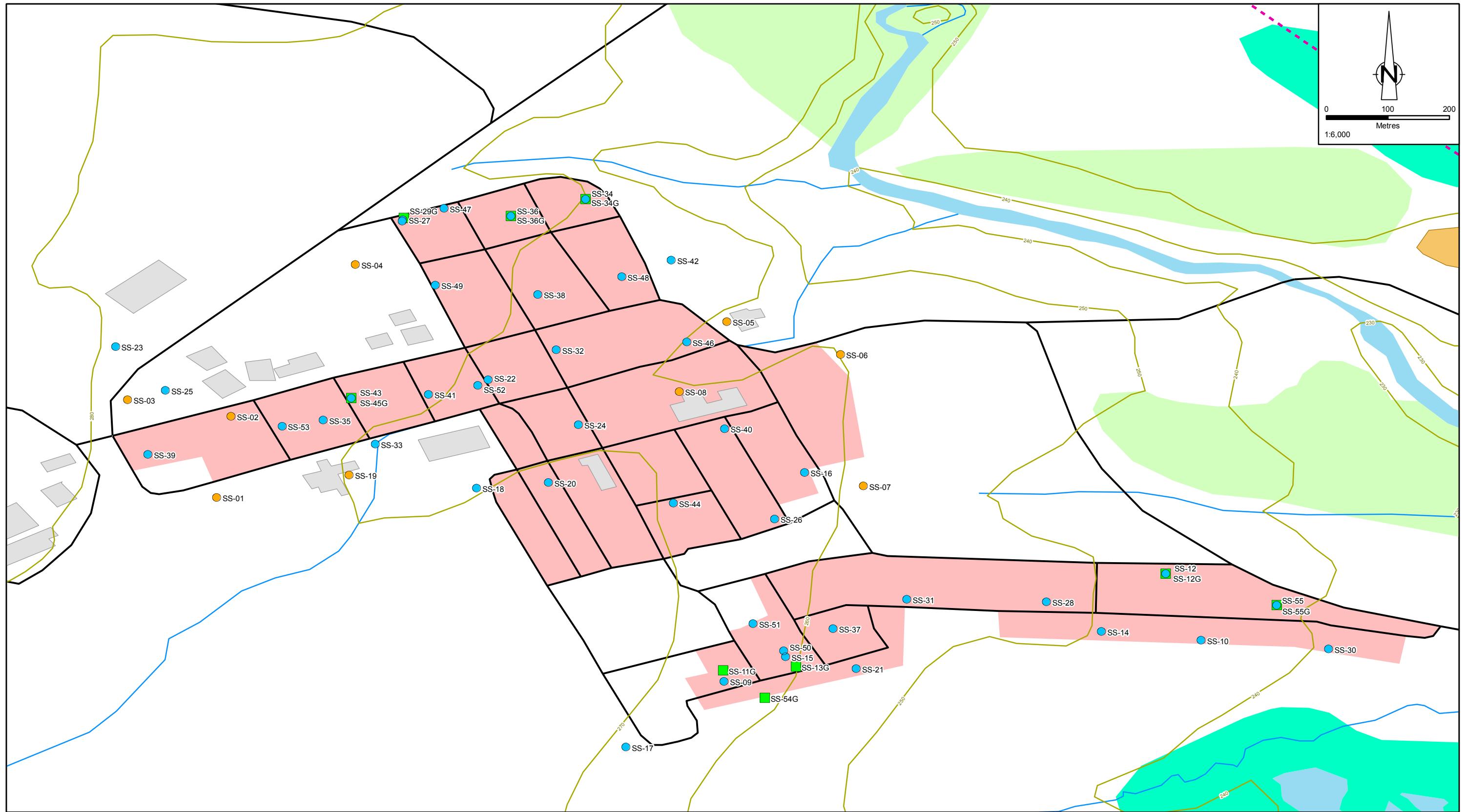


figure 1

**SURFICIAL SOIL SAMPLING LOCATIONS  
RESIDENTIAL SURFICIAL SOIL SAMPLING PROGRAM  
Buchans, NL**



**TABLE 1**  
**SURFICIAL SOIL SAMPLE KEY**  
**RESIDENTIAL SURFICIAL SOIL SAMPLING PROGRAM**  
**BUCHANS, NL**

<b>Sample ID</b>	<b>Sample Location</b>	<b>Sample Description</b>	<b>Sample Date</b>	<b>Depth (mbgs)</b>	<b>Analyses</b>
S-58704-101209-CH-01	SS-01	Tennis Court	Oct 12 2009	0 - 0.10	Metals
S-58704-101209-CH-02	SS-02	Buchans Miners' Museum - Park	Oct 12 2009	0 - 0.10	Metals
S-58704-101209-CH-03	SS-03	Memorial Park - Across from Red Ochre Inn	Oct 12 2009	0 - 0.10	Metals
S-58704-101209-CH-04	SS-04	Baseball Diamond	Oct 12 2009	0 - 0.10	Metals
S-58704-101209-ZZ-05	SS-05	Public Swimming Pool	Oct 12 2009	0 - 0.10	Metals
S-58704-101209-ZZ-06	SS-06	Public School/Library	Oct 12 2009	0 - 0.10	Metals
S-58704-101209-ZZ-07	SS-07	Children's (Public) Playground	Oct 12 2009	0 - 0.10	Metals
S-58704-101209-ZZ-08	SS-08	Mini-putt	Oct 12 2009	0 - 0.10	Metals
S-58704-101309-CH-09	SS-09	Rothermere Street	Oct 13 2009	0 - 0.10	Metals
S-58704-101309-ZZ-10	SS-10	Scott Street	Oct 13 2009	0 - 0.10	Metals
S-58704-101309-CH-11G	SS-11G	Rothermere Street	Oct 13 2009	0 - 0.10	Metals
S-58704-101309-ZZ-12	SS-12	Canning Street	Oct 13 2009	0 - 0.10	Metals
S-58704-101309-ZZ-12G	SS-12G	Canning Street	Oct 13 2009	0 - 0.10	Metals
S-58704-101309-CH-13G	SS-13G	Rothermere Street	Oct 13 2009	0 - 0.10	Metals
S-58704-101309-ZZ-14	SS-14	Scott Street	Oct 13 2009	0 - 0.10	Metals
S-58704-101309-CH-15	SS-15	Rothermere Street	Oct 13 2009	0 - 0.10	Metals
S-58704-101309-ZZ-16	SS-16	Lakeview Street	Oct 13 2009	0 - 0.10	Metals
S-58704-101309-CH-17	SS-17	McCuish Street	Oct 13 2009	0 - 0.10	Metals
S-58704-101309-ZZ-18	SS-18	Fire Pit on South Street	Oct 13 2009	0 - 0.10	Metals
S-58704-101309-CH-19	SS-19	Hospital Yard	Oct 13 2009	0 - 0.10	Metals
S-58704-101309-ZZ-20	SS-20	Jackson Street	Oct 13 2009	0 - 0.10	Metals
S-58704-101309-CH-21	SS-21	Rothermere Street	Oct 13 2009	0 - 0.10	Metals
S-58704-101309-ZZ-22	SS-22	Jackson Street	Oct 13 2009	0 - 0.10	Metals
S-58704-101309-CH-23	SS-23	Gilchrist Street	Oct 13 2009	0 - 0.10	Metals
S-58704-101309-ZZ-24	SS-24	Church Street	Oct 13 2009	0 - 0.10	Metals
S-58704-101309-CH-25	SS-25	Gilchrist Street	Oct 13 2009	0 - 0.10	Metals
S-58704-101309-ZZ-26	SS-26	Pine Avenue	Oct 13 2009	0 - 0.10	Metals
S-58704-101309-CH-27	SS-27	Jackson Street	Oct 13 2009	0 - 0.10	Metals
S-58704-101409-ZZ-28	SS-28	Scott Street	Oct 14 2009	0 - 0.10	Metals
S-58704-101309-CH-29G	SS-29G	Jackson Street	Oct 13 2009	0 - 0.10	Metals
S-58704-101409-ZZ-30	SS-30	Scott Street	Oct 14 2009	0 - 0.10	Metals
S-58704-101409-CH-31	SS-31	Amulree Street	Oct 14 2009	0 - 0.10	Metals
S-58704-101409-ZZ-32	SS-32	Church Street	Oct 14 2009	0 - 0.10	Metals
S-58704-101409-CH-33	SS-33	Prospect Street	Oct 14 2009	0 - 0.10	Metals
S-58704-101409-ZZ-34	SS-34	Williams Turn Pike	Oct 14 2009	0 - 0.10	Metals
S-58704-101409-ZZ-34G	SS-34G	Williams Turn Pike	Oct 14 2009	0 - 0.10	Metals
S-58704-101409-CH-35	SS-35	Prospect Street	Oct 14 2009	0 - 0.10	Metals
S-58704-101409-ZZ-36	SS-36	East Street	Oct 14 2009	0 - 0.10	Metals
S-58704-101409-ZZ-36G	SS-36G	East Street	Oct 14 2009	0 - 0.10	Metals
S-58704-101409-CH-37	SS-37	Scott Street	Oct 14 2009	0 - 0.10	Metals
S-58704-101409-ZZ-38	SS-38	Church Street	Oct 14 2009	0 - 0.10	Metals
S-58704-101409-CH-39	SS-39	Court Road	Oct 14 2009	0 - 0.10	Metals
S-58704-101409-ZZ-40	SS-40	Pine Avenue	Oct 14 2009	0 - 0.10	Metals
S-58704-101409-CH-41	SS-41	Center Street	Oct 14 2009	0 - 0.10	Metals
S-58704-101409-ZZ-42	SS-42	Williams Turn Pike	Oct 14 2009	0 - 0.10	Metals
S-58704-101409-CH-43	SS-43	Prospect Street	Oct 14 2009	0 - 0.10	Metals
S-58704-101509-ZZ-44	SS-44	Wolwyn Street	Oct 15 2009	0 - 0.10	Metals
S-58704-101409-CH-45G	SS-45G	Prospect Street	Oct 14 2009	0 - 0.10	Metals
S-58704-101509-ZZ-46	SS-46	Williams Turn Pike	Oct 15 2009	0 - 0.10	Metals
S-58704-101409-CH-47	SS-47	Church Street	Oct 14 2009	0 - 0.10	Metals
S-58704-101509-ZZ-48	SS-48	Williams Turn Pike	Oct 15 2009	0 - 0.10	Metals
S-58704-101409-CH-49	SS-49	Jackson Street	Oct 14 2009	0 - 0.10	Metals
S-58704-101509-CH-50	SS-50	Mitchell Street	Oct 15 2009	0 - 0.10	Metals
S-58704-101509-CH-51	SS-51	Glavine Street	Oct 15 2009	0 - 0.10	Metals
S-58704-101509-CH-52	SS-52	Jackson Street	Oct 15 2009	0 - 0.10	Metals
S-58704-101509-CH-53	SS-53	West Street	Oct 15 2009	0 - 0.10	Metals
S-58704-101509-CH-54G	SS-54G	Rothermere Street	Oct 15 2009	0 - 0.10	Metals
S-58704-101509-ZZ-55	SS-55	Scott Street	Oct 15 2009	0 - 0.10	Metals
S-58704-101509-ZZ-55G	SS-55G	Scott Street	Oct 15 2009	0 - 0.10	Metals

Note:

mbgs - metres below ground surface

TABLE 2

**SURFICIAL SOIL ANALYTICAL RESULTS**  
**RESIDENTIAL SURFICIAL SOIL SAMPLING PROGRAM**  
**BUCHANS, NL**

Sample Location:	SS-01	SS-02	SS-03	SS-04	SS-05	SS-06	SS-07	SS-08	SS-09	SS-10	SS-11G	SS-12			
Sample Description:	Tennis Court	Buchans Miners' Museum	Memorial Park	Baseball Diamond	Public Swimming Pool	Public School/Library	Public School/Library	Children's (Public) Playground	Mini-putt	Rothermere Street	Scott Street	Rothermere Street	Canning Street		
Sample ID:	S-58704-101209-CH-01	S-58704-101209-CH-02	S-58704-101209-CH-03	S-58704-101209-CH-04	S-58704-101209-ZZ-05	S-58704-101209-ZZ-06	S-58704-101209-ZZ-06	S-58704-101209-ZZ-07	S-58704-101209-ZZ-08	S-58704-101209-CH-09	S-58704-101309-ZZ-10	S-58704-101309-CH-11G	S-58704-101309-ZZ-12		
Sample Date:	10/12/2009	10/12/2009	10/12/2009	10/12/2009	10/12/2009	10/12/2009	10/12/2009	10/12/2009	10/12/2009	10/13/2009	10/13/2009	10/13/2009	10/13/2009		
Sample Depth:	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs		
Parameters	Units	(a)						Laboratory Duplicate							
Metals															
Aluminum	mg/kg	-	8500	14000	10000	8700	12000	11000	5500	9400	10000	9400	11000	8200	
Antimony	mg/kg	20	7	ND (2)	4	4	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	2	ND (2)	ND (2)	
Arsenic	mg/kg	12	37	12	15	12	5	10	11	ND (2)	7	11	9	5	
Barium	mg/kg	500	1000	480	910	670	580	310	370	200	380	1400	700	910	640
Beryllium	mg/kg	4	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	
Bismuth	mg/kg	-	2	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	
Boron	mg/kg	-	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	
Cadmium	mg/kg	10	3.3	1.9	3.6	5.2	1.4	1.0	1.2	0.4	1.5	2.0	0.8	1.3	
Chromium	mg/kg	64	13	24	14	9	8	20	19	7	14	10	9	12	
Cobalt	mg/kg	50	4	11	5	4	3	8	8	4	6	4	2	4	
Copper	mg/kg	63	300	59	270	100	71	41	50	24	57	71	71	76	
Iron	mg/kg	-	20000	27000	17000	13000	16000	18000	18000	11000	16000	13000	12000	16000	12000
Lead	mg/kg	140	1500	210	1200	780	350	220	250	84	270	350	480	320	320
Lithium	mg/kg	-	7	11	6	4	3	8	9	3	7	4	3	4	4
Manganese	mg/kg	-	260	840	280	200	160	390	420	210	380	320	98	170	260
Mercury	mg/kg	6.6	0.3	ND (0.1)	0.2	0.2	0.1	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.2	0.1	0.1	0.1
Molybdenum	mg/kg	10	5	ND (2)	2	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)
Nickel	mg/kg	50	6	18	8	4	4	16	15	4	9	5	3	5	6
Rubidium	mg/kg	-	ND (2)	3	ND (2)	ND (2)	ND (2)	2	3	ND (2)	2	2	3	2	ND (2)
Selenium	mg/kg	1	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)
Silver	mg/kg	20	5.3	0.6	2.7	3.3	0.8	ND (0.5)	ND (0.5)	ND (0.5)	0.7	1.0	0.9	0.6	0.6
Strontium	mg/kg	-	19	13	16	11	10	12	13	6	11	20	11	13	11
Thallium	mg/kg	1	0.5	ND (0.1)	0.2	0.3	0.1	ND (0.1)	ND (0.1)	ND (0.1)	0.4	0.4	0.3	0.1	0.1
Tin	mg/kg	50	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)
Uranium	mg/kg	23	0.8	0.7	0.7	0.9	0.5	0.6	0.6	0.5	0.6	2.2	0.5	0.7	0.9
Vanadium	mg/kg	130	51	46	41	30	30	39	37	26	33	33	36	43	29
Zinc	mg/kg	200	930	390	780	1400	310	240	270	120	490	460	660	230	200

## Notes:

- Not applicable/Not analyzed.  
 ND - Not detected at associated value.

- Concentration is greater than applicable criterion

(a) - CCME Table 1 Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (Updated 7.0, Updated September 2007) coarse-grained soils for Residential/Parkland use

mbgs - metres below ground surface

TABLE 2

**SURFICIAL SOIL ANALYTICAL RESULTS**  
**RESIDENTIAL SURFICIAL SOIL SAMPLING PROGRAM**  
**BUCHANS, NL**

Sample Location:	SS-12G	SS-13G	SS-14	SS-15	SS-16	SS-17	SS-18	SS-19	SS-20	SS-21	SS-22	SS-23	SS-24		
Sample Description:	Canning Street	Rothermere Street	Scott Street	Rothermere Street	Lakeview Street	McCuish Street	Fire Pit on South Street	Hospital Yard	Jackson Street	Rothermere Street	Jackson Street	Gilchrist Street	Church Street		
Sample ID:	S-58704-101309-ZZ-12G	S-58704-101309-CH-13G	S-58704-101309-ZZ-14	S-58704-101309-CH-15	S-58704-101309-ZZ-16	S-58704-101309-CH-17	S-58704-101309-ZZ-18	S-58704-101309-CH-19	S-58704-101309-ZZ-20	S-58704-101309-CH-21	S-58704-101309-ZZ-22	S-58704-101309-CH-23	S-58704-101309-ZZ-24		
Sample Date:	10/13/2009	10/13/2009	10/13/2009	10/13/2009	10/13/2009	10/13/2009	10/13/2009	10/13/2009	10/13/2009	10/13/2009	10/13/2009	10/13/2009	10/13/2009		
Sample Depth:	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs		
Parameters	Units	(a)													
Metals															
Aluminum	mg/kg	-	4700	11000	8500	12000	9700	13000	9000	10000	8700	8600	9300	11000	
Antimony	mg/kg	20	ND (2)	ND (2)	2	4	3	ND (2)	6	4					
Arsenic	mg/kg	12	ND (2)	7	3	11	7	10	12	23	14	9	6	17	21
Barium	mg/kg	500	290	430	710	1500	750	1200	1100	1900	1400	910	290	690	1700
Beryllium	mg/kg	4	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)				
Bismuth	mg/kg	-	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)				
Boron	mg/kg	-	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)				
Cadmium	mg/kg	10	1.2	0.7	1.5	2.3	4.0	2.7	0.9	8.3	3.5	1.4	0.7	5.8	4.9
Chromium	mg/kg	64	6	8	12	11	10	11	9	21	18	9	15	10	16
Cobalt	mg/kg	50	1	4	3	3	4	3	3	5	3	3	7	3	4
Copper	mg/kg	63	45	24	69	99	120	90	110	290	150	58	290	220	220
Iron	mg/kg	-	6200	17000	11000	15000	13000	16000	12000	14000	12000	12000	16000	15000	16000
Lead	mg/kg	140	120	78	450	510	660	480	440	1200	850	290	270	1600	1400
Lithium	mg/kg	-	2	5	3	4	3	4	4	5	3	4	7	4	4
Manganese	mg/kg	-	240	640	760	260	250	310	140	300	180	240	340	210	420
Mercury	mg/kg	6.6	0.1	0.1	ND (0.1)	0.2	0.2	0.1	ND (0.1)	0.4	0.3	ND (0.1)	ND (0.1)	0.2	0.3
Molybdenum	mg/kg	10	ND (2)	2	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	2	ND (2)	ND (2)	ND (2)	3	3
Nickel	mg/kg	50	ND (2)	4	5	4	5	5	5	13	5	5	11	4	6
Rubidium	mg/kg	-	ND (2)	2	ND (2)	2	ND (2)	ND (2)	ND (2)	2	ND (2)	2	ND (2)	ND (2)	ND (2)
Selenium	mg/kg	1	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)				
Silver	mg/kg	20	0.7	ND (0.5)	0.6	1.4	1.1	1.0	1.3	3.5	1.9	0.8	0.5	4.2	2.6
Strontium	mg/kg	-	17	9	18	24	15	19	15	27	20	14	9	16	22
Thallium	mg/kg	1	ND (0.1)	ND (0.1)	ND (0.1)	0.2	0.1	0.2	0.3	0.5	0.3	0.2	ND (0.1)	0.2	0.3
Tin	mg/kg	50	ND (2)	ND (2)	ND (2)	ND (2)	4	ND (2)	ND (2)	ND (2)	4				
Uranium	mg/kg	23	1.7	2.7	0.9	1.2	0.8	1.3	0.5	7.9	1.5	0.6	0.6	0.6	9.5
Vanadium	mg/kg	130	15	35	30	38	33	36	35	63	39	23	37	30	45
Zinc	mg/kg	200	210	160	410	510	800	630	200	1300	550	300	200	1400	910

## Notes:

- Not applicable/Not analyzed.  
 ND - Not detected at associated value.

- Concentration is greater than applicable criterion

(a) - CCME Table 1 Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (Updated 7.0, Updated September 2007) coarse-grained soils for Residential/Parkland use

mbgs - metres below ground surface

TABLE 2

**SURFICIAL SOIL ANALYTICAL RESULTS**  
**RESIDENTIAL SURFICIAL SOIL SAMPLING PROGRAM**  
**BUCHANS, NL**

Sample Location:	SS-25	SS-26	SS-27	SS-28	SS-29G	SS-29G	SS-30	SS-31	SS-32	SS-33	SS-34	SS-34G	SS-35
Sample Description:	Gilchrist Street	Pine Avenue	Jackson Street	Scott Street	Jackson Street	Jackson Street	Scott Street	Amulree Street	Church Street	Prospect Street	Williams Turn Pike	Williams Turn Pike	Prospect Street
Sample ID:	S-58704-101309-CH-25	S-58704-101309-ZZ-26	S-58704-101309-CH-27	S-58704-101409-ZZ-28	S-58704-101309-CH-29G	S-58704-101309-CH-29G	S-58704-101409-ZZ-30	S-58704-101409-CH-31	S-58704-101409-ZZ-32	S-58704-101409-CH-33	S-58704-101409-ZZ-34	S-58704-101409-ZZ-34G	S-58704-101409-CH-35
Sample Date:	10/13/2009	10/13/2009	10/13/2009	10/14/2009	10/13/2009	10/13/2009	10/14/2009	10/14/2009	10/14/2009	10/14/2009	10/14/2009	10/14/2009	10/14/2009
Sample Depth:	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs				
Parameters	Units	Laboratory Duplicate											
		(a)											
Metals													
Aluminum	mg/kg	-	7100	9600	10000	5400	7800	7600	9500	8600	7400	7900	7300
Antimony	mg/kg	20	ND (2)	2	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)
Arsenic	mg/kg	12	7	10	7	2	5	5	3	6	2	4	4
Barium	mg/kg	500	500	770	660	170	380	340	300	870	280	610	1100
Beryllium	mg/kg	4	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)
Bismuth	mg/kg	-	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)
Boron	mg/kg	-	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)
Cadmium	mg/kg	10	2.2	2.8	2.0	ND (0.3)	0.5	0.6	0.7	1.5	0.4	0.7	2.5
Chromium	mg/kg	64	14	9	9	7	5	6	9	13	7	9	15
Cobalt	mg/kg	50	4	3	4	3	4	3	3	4	3	4	5
Copper	mg/kg	63	89	100	66	22	26	26	33	57	28	37	480
Iron	mg/kg	-	12000	11000	14000	10000	14000	14000	14000	12000	11000	12000	18000
Lead	mg/kg	140	410	580	420	54	100	110	98	340	100	240	3100
Lithium	mg/kg	-	5	4	4	3	4	4	4	4	3	4	5
Manganese	mg/kg	-	250	340	240	200	720	550	230	280	170	190	250
Mercury	mg/kg	6.6	ND (0.1)	0.2	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.1	ND (0.1)	ND (0.1)	1.0
Molybdenum	mg/kg	10	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)
Nickel	mg/kg	50	6	4	4	3	2	3	4	6	3	4	9
Rubidium	mg/kg	-	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)
Selenium	mg/kg	1	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)
Silver	mg/kg	20	0.8	1.1	0.9	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	0.6	ND (0.5)	0.5	5.0
Strontium	mg/kg	-	10	16	12	6	7	12	6	14	7	11	29
Thallium	mg/kg	1	ND (0.1)	0.3	ND (0.1)	ND (0.1)	0.1	ND (0.1)	0.1	ND (0.1)	ND (0.1)	0.3	15
Tin	mg/kg	50	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)	ND (2)
Uranium	mg/kg	23	0.9	1.1	1.2	1.5	1.8	1.9	0.8	0.8	0.6	1.8	1.2
Vanadium	mg/kg	130	33	31	29	27	25	27	34	35	23	34	43
Zinc	mg/kg	200	420	510	460	83	110	110	180	380	110	160	2100

## Notes:

- Not applicable/Not analyzed.  
 ND - Not detected at associated value.

 - Concentration is greater than applicable criterion

(a) - CCME Table 1 Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (Updated 7.0, Updated September 2007) coarse-grained soils for Residential/Parkland use

mbgs - metres below ground surface

TABLE 2

**SURFICIAL SOIL ANALYTICAL RESULTS**  
**RESIDENTIAL SURFICIAL SOIL SAMPLING PROGRAM**  
**BUCHANS, NL**

Sample Location:	SS-36	SS-36G	SS-37	SS-38	SS-39	SS-40	SS-40	SS-41	SS-42	SS-43	SS-44	SS-45G	SS-46
Sample Description:	East Street	East Street	Scott Street	Church Street	Court Road	Pine Avenue	Pine Avenue	Center Street	Williams Turn Pike	Prospect Street	Wolwyn Street	Prospect Street	Williams Turn Pike
Sample ID:	S-58704-101409-ZZ-36	S-58704-101409-ZZ-36G	S-58704-101409-CH-37	S-58704-101409-ZZ-38	S-58704-101409-CH-39	S-58704-101409-ZZ-40	S-58704-101409-ZZ-40	S-58704-101409-CH-41	S-58704-101409-ZZ-42	S-58704-101409-CH-43	S-58704-101409-ZZ-44	S-58704-101409-CH-45G	S-58704-101509-ZZ-46
Sample Date:	10/14/2009	10/14/2009	10/14/2009	10/14/2009	10/14/2009	10/14/2009	10/14/2009	10/14/2009	10/14/2009	10/14/2009	10/14/2009	10/14/2009	10/15/2009
Sample Depth:	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs
Parameters	Units	(a)						Laboratory Duplicate					
Metals													
Aluminum	mg/kg	-	9200	8200	8100	12000	5700	7800	8500	9000	9600	6600	9500
Antimony	mg/kg	20	ND (2)	ND (2)	ND (2)	15	ND (2)	10	8	4	ND (2)	ND (2)	ND (2)
Arsenic	mg/kg	12	5	2	5	23	7	37	42	9	6	4	6
Barium	mg/kg	500	380	200	680	1500	850	280	320	720	790	840	1300
Beryllium	mg/kg	4	ND (2)	ND (2)									
Bismuth	mg/kg	-	ND (2)	3	4	ND (2)	ND (2)	ND (2)	ND (2)				
Boron	mg/kg	-	ND (5)	ND (5)									
Cadmium	mg/kg	10	1.0	0.5	0.8	5.0	2.9	14	18	2.3	2.4	1.7	1.5
Chromium	mg/kg	64	9	8	7	15	7	11	13	9	11	9	11
Cobalt	mg/kg	50	3	3	3	5	3	4	5	3	2	3	4
Copper	mg/kg	63	41	22	35	500	160	530	700	200	77	58	61
Iron	mg/kg	-	14000	10000	12000	22000	10000	17000	19000	13000	12000	9300	12000
Lead	mg/kg	140	230	58	170	3300	750	2900	3200	990	530	310	450
Lithium	mg/kg	-	4	5	4	5	3	6	6	3	3	3	5
Manganese	mg/kg	-	300	310	180	240	160	380	370	200	230	210	290
Mercury	mg/kg	6.6	ND (0.1)	ND (0.1)	ND (0.1)	0.5	0.1	0.3	0.3	0.2	0.2	ND (0.1)	ND (0.1)
Molybdenum	mg/kg	10	ND (2)	ND (2)	ND (2)	4	ND (2)	6	7	2	ND (2)	ND (2)	ND (2)
Nickel	mg/kg	50	4	5	3	8	4	6	6	4	3	3	5
Rubidium	mg/kg	-	ND (2)	ND (2)	ND (2)	4	ND (2)	ND (2)					
Selenium	mg/kg	1	ND (2)	2	ND (2)	ND (2)							
Silver	mg/kg	20	ND (0.5)	ND (0.5)	ND (0.5)	4.6	1.4	5.0	5.7	1.3	0.7	0.6	0.9
Strontium	mg/kg	-	8	20	11	29	14	11	12	11	19	18	28
Thallium	mg/kg	1	ND (0.1)	ND (0.1)	ND (0.1)	0.1	0.3	ND (0.1)	1.1	0.9	ND (0.1)	ND (0.1)	ND (0.1)
Tin	mg/kg	50	8	ND (2)	ND (2)	7	ND (2)	ND (2)	ND (2)	3	ND (2)	2	ND (2)
Uranium	mg/kg	23	1.2	1.1	1.0	0.7	0.6	1.6	1.5	1.0	7.1	1.2	0.7
Vanadium	mg/kg	130	28	20	30	44	33	25	27	30	35	21	26
Zinc	mg/kg	200	230	110	260	840	560	4000	5100	500	560	320	270

## Notes:

- Not applicable/Not analyzed.  
 ND - Not detected at associated value.

  - Concentration is greater than applicable criterion

(a) - CCME Table 1 Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (Updated 7.0, Updated September 2007) coarse-grained soils for Residential/Parkland use

mbgs - metres below ground surface

TABLE 2

**SURFICIAL SOIL ANALYTICAL RESULTS**  
**RESIDENTIAL SURFICIAL SOIL SAMPLING PROGRAM**  
**BUCHANS, NL**

Sample Location:	SS-47	SS-48	SS-49	SS-50	SS-51	SS-52	SS-53	SS-54G	SS-55	SS-55G
Sample Description:	Church Street	Williams Turn Pike	Jackson Street	Mitchell Street	Glavine Street	Jackson Street	West Street	Rothermere Street	Scott Street	Scott Street
Sample ID:	S-58704-101409-CH-47	S-58704-101509-ZZ-48	S-58704-101409-CH-49	S-58704-101509-CH-50	S-58704-101509-CH-51	S-58704-101509-CH-52	S-58704-101509-CH-53	S-58704-101509-CH-54G	S-58704-101509-ZZ-55	S-58704-101509-55G
Sample Date:	10/14/2009	10/15/2009	10/14/2009	10/15/2009	10/15/2009	10/15/2009	10/15/2009	10/15/2009	10/15/2009	10/15/2009
Sample Depth:	CCME Residential/ Parkland	0 - 0.1 mbgs	0 - 0.1 mbgs	0 - 0.1 mbgs						
Parameters	Units	(a)								
Metals										
Aluminum	mg/kg	-	7600	5800	8400	7800	11000	7800	9500	8700
Antimony	mg/kg	20	ND (2)	5	ND (2)	3	ND (2)	3	ND (2)	ND (2)
Arsenic	mg/kg	12	6	8	5	14	8	12	7	5
Barium	mg/kg	500	1100	1200	820	1600	880	1400	590	280
Beryllium	mg/kg	4	ND (2)	ND (2)	ND (2)					
Bismuth	mg/kg	-	ND (2)	ND (2)	ND (2)					
Boron	mg/kg	-	ND (5)	ND (5)	ND (5)					
Cadmium	mg/kg	10	3.2	2.0	3.6	2.8	0.9	5.6	1.5	0.3
Chromium	mg/kg	64	9	11	17	12	14	13	13	11
Cobalt	mg/kg	50	3	3	3	4	5	4	5	5
Copper	mg/kg	63	120	130	130	76	35	130	75	22
Iron	mg/kg	-	11000	13000	10000	16000	17000	15000	14000	15000
Lead	mg/kg	140	670	1300	560	510	160	910	410	42
Lithium	mg/kg	-	4	4	3	4	6	4	6	6
Manganese	mg/kg	-	320	190	220	360	450	430	240	290
Mercury	mg/kg	6.6	0.2	0.2	0.3	0.1	ND (0.1)	0.2	0.1	ND (0.1)
Molybdenum	mg/kg	10	ND (2)	ND (2)	ND (2)					
Nickel	mg/kg	50	4	4	5	6	8	6	8	7
Rubidium	mg/kg	-	ND (2)	ND (2)	ND (2)	2	3	ND (2)	ND (2)	2
Selenium	mg/kg	1	ND (2)	ND (2)	ND (2)	ND (2)	3	ND (2)	ND (2)	ND (2)
Silver	mg/kg	20	1.4	1.5	1.1	1.2	ND (0.5)	1.7	0.8	ND (0.5)
Strontium	mg/kg	-	24	18	21	30	14	22	11	16
Thallium	mg/kg	1	ND (0.1)	0.1	0.1	0.3	0.1	0.2	ND (0.1)	ND (0.1)
Tin	mg/kg	50	ND (2)	3	ND (2)	4	ND (2)	3	ND (2)	ND (2)
Uranium	mg/kg	23	1.9	0.4	7.9	0.6	2.0	2.8	1.0	1.0
Vanadium	mg/kg	130	22	25	26	29	34	34	33	32
Zinc	mg/kg	200	750	400	810	620	200	1200	350	97

## Notes:

- Not applicable/Not analyzed.

ND - Not detected at associated value.

[red box] - Concentration is greater than applicable criterion

(a) - CCME Table 1 Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (Updated 7.0, Updated September 2007) coarse-grained soils for Residential/Parkland use

mbgs - metres below ground surface