RISK MANAGEMENT PLAN FOR PUBLIC AREAS

BUCHANS, NEWFOUNDLAND AND LABRADOR

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EXECUTIVE SUMMARY

This report presents the results of a surficial soil sampling program and a Risk Management Plan (RMP) that was developed for lead in soil exceedances for Public Areas in the Town of Buchans, Newfoundland and Labrador (Town). Assessment work was also completed for residential areas and was reported separately. For the purposes of developing this RMP, Public Areas were defined as areas owned and operated by the Town such as Veteran's Memorial, ball field, tennis courts, playground, swimming pool, museum, community centre, etc. Additional investigations were conducted to document environmental conditions at Buchans that included the hand excavation of shallow test holes followed by the collection and analysis of soil samples.

Based on a file review of available environmental documents pertaining to the Town and in consultation with the Province, a sampling program was developed to delineate previously confirmed lead concentrations in soil above the Risk-Based Concentration (RBC). The northern section of Town was sub-divided into 8 Zones that were bounded by pre-existing geographical features such as roads, fences, etc. Soil investigations were then completed between June 23 and 29, 2010 to assess environmental conditions in Public Areas.

In order to assess the significance of the data and to aid in determining the scope of remediation and/or closure to be completed at each Zone, CRA compared the lead in soil data to the RBC developed in the CRA 2010 Summary Human Health Risk Assessment (HHRA) report. The RBC was determined to be 622 mg/kg for lead in soil.

CRA investigated 8 zones in the northern area of Town as shown on Figure 2. CRA combined the analytical data for samples collected from the CRA 2009 Phase II Environmental Site Assessment (ESA), 2010 HHRA, and 2010 RMP.

The following table presents a summary of the lead impacted surface soils for Public Areas by Zone in each location with areas of impacted lead in soil concentrations that exceeded the RBC criterion.

Zone		*Net Area*	*Lead Concentrations*
Number	*Location*	*(m^2)*	*Soil (mg/kg)*
1	Veteran's Memorial	4,000	1,200
1	Ball field	7,500	780
4	Tennis Court area, west side	2,250	1,500
4	Tennis Court area, south side	1,100	3,600 – 4,500

Zone		Net Area	Lead Concentrations
Number	*Location*	*(m^2)*	*Soil (mg/kg)*
4	Health care facility courtyard, south side	1,650	1,200

Impacts to Public Areas were not identified in the following Zones:

- Zone 2 – William's Turnpike, Jackson, North
- Zone 3 – North, Jackson, Main, William's Turnpike, Sleepy Valley
- Zone 5 – Main, Center, South, Church
- Zone 6 – Main, Church, South, Lake, William's Turnpike
- Zone 7 – South, Laycock, Walsh Memorial, Lundberg
- Zone 8 – South, Lundberg, Walsh Memorial, Lakeview

Risk management alternatives are directly influenced by such factors as existing property usage (playground, parking lot, etc.), exposure scenarios based on dermal contact limited by surface cover (grass, gravel, asphalt, concrete, etc.) or construction activities (disturbing surface or sub-surface soil), and costs associated with each alternative. In an effort to mitigate lead in soil exceedances reported from the 2009 and 2010 surface soil sampling programs at Public Areas in the Town, CRA considered potential alternatives during the development of this RMP as summarized below.

- Restrict usage to limit exposures and/or use of the Public Areas by directing users to wear appropriate personal protective equipment (PPE), thereby blocking potential dermal contact;
- Import and placement of clean imported soil over the existing surfaces followed by reinstatement of landscaping;
- Removal of lead impacted soil with disposal at an approved waste disposal site, import and place clean soil with reinstatement of landscaping; and
- Any combination of the previously listed options.

A variety of landscaped surfaces currently exist at the various public locations where RMPs are required. For example, the ball field has a sand infield, sodded outfield, and gravel area outside the playing field.

The estimated costs were derived from similar work that CRA completed in New Brunswick as well as recent civil works completed in Buchans, NL during the 2010 construction season. A slight allowance for inflation (5 percent) was also included to account for an extended remedial plan that may be completed in stages. Estimates for the proposed remedial alternatives described in this report are provided under separate cover.

A number of factors were considered in developing a preferred RMP for each of the four Public Areas addressed herein. Firstly, the type of remedial control measure was greatly influenced by existing landscaping finishes, which, in turn, directly influenced estimated costs. For example, the ball field has a sand infield, gravel outfield, and gravel area outside the playing field. Therefore, the type of finished landscaping will be driven by existing conditions and the Town, since they will be the end user responsible for maintenance of these areas. The second issue of consideration related to the priority of completing the remedial work based on a review of potential exposure through dermal contact for one location in comparison to others within the group of Public Areas that were scrutinized. The Public Areas with lead impacted soil above the RBC along with recommended remedial option and prioritization is summarized in the table below.

Zone		*Recommended Remedial Option*	*Priority*
Number	*Location*		
1	Veteran's Memorial	Removal of 0.3 metres and reinstate	Low
1	Ball field	Placement of fill/gravel	High
4	Tennis Court area, west side	Removal of 0.3 metres and reinstate	High
4	Tennis Court area, south side	Removal of 0.3 metres and reinstate	High
4	Health care facility courtyard, south side	Removal of 0.3 metres and reinstate	Low

CRA recommend that the preferred remedial options be implemented to address High priority Public Areas first.

It is also noted that several risk management alternatives include the removal and disposal of lead-impacted soil at a disposal facility approved by the Province. At the time of writing this report, a soil disposal facility does not exist that is approved by the Province for disposal of lead impacted soil; therefore, all lead impacted soil being removed from areas within the Town would require transportation to a facility off the island for disposal. This approach would result in extremely high disposal costs that would render such a remedial alternative as economically unfeasible.

CRA recommend that lead-impacted soil removed from Public Areas in the Town should be disposed of at a location determined by the Province and the Town that would be nearby Buchans. Such an alternative would require an engineered facility that would meet the same construction criteria as that recently completed for the TSA in 2010. An added benefit to nearby disposal is that completion time for construction activities would be dramatically reduced compared to off-island disposal.

TABLE OF CONTENTS

LIST OF FIGURES
(Following Text)

LIST OF TABLES
(Following Text)

LIST OF APPENDICES

1.0 INTRODUCTION

This report presents the results of a surficial soil sampling program and a Risk Management Plan (RMP) that was developed with lead in soil exceedances for Public Areas in the Town of Buchans, Newfoundland and Labrador (Town). Assessment work was also completed for residential areas and was reported separately. For the purposes of developing this RMP, Public Areas were defined as areas owned and operated by the Town such as Veteran's Memorial, ball field, tennis courts, playground, swimming pool, museum, community centre, etc. Conestoga-Rovers & Associates (CRA) has prepared this report on behalf of the Province of Newfoundland and Labrador, Department of Environment and Conservation (Province). Additional investigations were conducted to document environmental conditions at Buchans that included the hand excavation of shallow test holes followed by the collection and analysis of soil samples.

The Scope of Work (SOW) for the RMP was developed based on the "*Summary Report, Human Health Risk Assessment (HHRA)*" report (March 2010), prepared by CRA for Weirfoulds on behalf of the Province. This report evaluated potential human health impacts due to the deposition of dusts containing metals from historic mining and waste disposal around the Town. The findings from the CRA Summary HHRA report have been summarized in Section 2.3 of this report.

Field investigations at the Town were conducted between June 23 and 29, 2010.

The remainder of this report is organized as follows:

- Section 2.0 – Site Overview and History
- Section 3.0 – Environmental Setting
- Section 4.0 – Field Activities
- Section 5.0 – Applicable Regulatory Criteria and Guidance
- Section 6.0 – Analytical Results
- Section 7.0 – Summary of Lead Impacted Soil in Public Areas
- Section 8.0 – Risk Management Alternatives
- Section 9.0 – Recommendations
- Section 10.0 – References

2.0 SITE OVERVIEW AND HISTORY

2.1 SITE LOCATION AND DESCRIPTION

The Town is located approximately 10 kilometres (km) northwest of Red Indian Lake in west-central Newfoundland and Labrador (NL). The Site Location Map is presented on Figure 1 and a Site Plan of the study area is presented on Figure 2.

2.2 FORMER SITE OPERATIONS

Major operations at Buchans formerly included mining activities that collectively operated from 1906 until 1984, which included ore extraction and milling operations. Base metal ores, predominantly copper, lead, and zinc, were extracted from the five mines around the Town, transported to the mill, and refined. The main production area of the former mine was west of the Town, where the high-grade ore was processed and concentrated. The mining operations resulted in the extraction and milling of 16,247,100 tonnes of ore, the generation of approximately 10,473,000 tonnes of mine tailings that consisted of approximately 10 percent solids and the generation of approximately 4,600,000 tonnes of waste rock.

Tailings from the floatation refinement process were initially discharged through a wooden sluice to the Buchans River. Occassionally, mine tailings would overflow the wooden sluice at the Tailings Spill Area (TSA); during emergency mill shut downs, ore concentrates and tailings were discharged directly into the TSA area to prevent drying or freezing of the material in the mill equipment. In 1965, tailings and mine discharge water were diverted to a temporary tailings pond, which was located on the northern edge of the existing Tailings Pond 1. Waste rock (rock that was not rich in ore) extracted from each of the mine sites was disposed of in areas immediately adjacent to each mine.

The available surficial soil data collected during the 2009 sampling events provides a clear soil quality distinction between the north and south residential sections of Town, with all tested properties in the south section having lead levels below the Risk-Based Concentration (RBC) developed in the CRA 2010 Summary HHRA report. Based on this clear distinction, CRA concluded that supplemental soil testing was not necessary in the south residential section of Town; therefore, the focus was on the north section of Town where a high percentage of tested properties exceeded the RBC for lead.

2.3 PREVIOUS INVESTIGATIONS

AMEC conducted a Phase I Environmental Site Assessment (ESA) from August 18 to 21, 2008 and identified 23 Potential Areas of Concern (PAOCs) and other areas of environmental concern; Public Areas were not specifically identified or assessed as a PAOC. Additional details are provided in the report entitled: "*Former ASARCO Mine Site, Phase I Environmental Site Assessment, Buchans, Newfoundland and Labrador*" dated March 2009, (AMEC Phase I ESA).

CRA completed a Phase II ESA for the Town and former surrounding mine infrastructure on behalf of the Province in 2009. The SOW was based on a review of previous environmental reports, a Site reconnaissance inspection, interviews with former mine employees and Town representatives, and a review of additional documents provided by the Province. A total of 33 PAOCs were identified as a result of the Phase II ESA with impacts above generic environmental criteria identified in 30 of the 33 PAOCs investigated. The Phase II ESA concluded that there were 30 PAOCs where remediation was required, one of which was the Public and Residential areas in Town. Additional studies at the remaining 29 PAOCs (located outside Town) with respect to impacted media (soil, groundwater, surface water sediments) have yet to be completed. Additional details are provided in the report entitled: "*Environmental Site Assessment, Abitibi-Consolidated Inc. – Buchans Site, Buchans, Newfoundland*" dated November 2009, (CRA 2009 Phase II ESA).

CRA completed a HHRA for the Province in 2010 that related to impacted surface soil in the Town affected by deposition of metals from historic mining operations and mining waste rock management practices. CRA collected 71 surface soil samples from residential and recreational locations in and around the Town in August and October 2009, all of which were analyzed for total metals; representative samples were also analyzed for metal bio-availability, i.e., the fraction of metals that can be absorbed by the gastrointestinal tract, and local climatic conditions. CRA compared the analytical results to screening criteria developed by federal and provincial agencies to identify metals of interest (MOI), i.e., metals with maximum concentrations that were greater than these generic criteria. Nine metal exceedances were evaluated during the CRA 2010 HHRA where RBCs were developed for each metal. CRA then compared the concentration of MOI in each sample to the site-specific RBCs to identify locations where the MOI concentrations were greater than the site-specific RBC; the MOIs were reduced to only two (arsenic and lead). Additional details are provided in the report entitled: "*Human Health Risk Assessment, Town of Buchans, Buchans, Newfoundland and Labrador*" dated March 2010, (CRA 2010 HHRA).

CRA completed a summary of previous assessment work for the Province in 2010 that specifically targeted residential and Public Areas of Town to evaluate lead and arsenic impacted surface soils. The location where arsenic exceeded its respective RBC was mitigated during the summer of 2010 when the TSA was capped and the Mucky Ditch was remediated. The concise results of the summary HHRA concluded that concentrations of lead in surface soils were greater than its site-specific RBC at 20 residential locations in Town. A final recommendation was to develop a RMP to mitigate potential exposure to these metals (primarily for small children). Additional details are provided in the report entitled: "*Summary Report, Human Health Risk Assessment, Town of Buchans, Buchans, Newfoundland and Labrador*" dated March 2010, (CRA 2010 Summary HHRA).

3.0 ENVIRONMENTAL SETTING

3.1 REGIONAL GEOLOGY

Based upon a review of maps from the Geologic Survey (Newfoundland and Labrador) Department of Natural Resources (2004), the Site is located within the Dunnage Zone, which consists of volcanic and sedimentary rocks. Natural Resources Canada's MIRAGE (Map Image Rendering Database for Geoscience) system shows the area to be composed of volcanic rocks with basic and ultrabasic intrusions and some sedimentary rocks, deformed and metamorphosed. Review of MIRAGE also reveals the Town is located within the geologic province of Appalachian Orogen, the rocks are Paleozoic in age, and there may be basalt, rhyolite, tuff, breccia, and minor subaqueous conglomerates.

3.2 LOCAL GEOLOGY

The "Geology of the Island of Newfoundland", issued by the Department of Mines and Energy, Government of Newfoundland and Labrador (Map 90-01) indicates the Town is underlain by Cambrian to Middle Ordovician stratified rocks including submarine mafic, intermediate and felsic volcanic rocks, including mafic volcanic rocks of ophiolite complexes; mafic rocks predominate in the northern Dunnage Zone and felsic rocks in the south. The bedrock includes unseparated intrusive, sedimentary and metamorphic rocks.

The "Surficial Geology of Insular Newfoundland, Preliminary Version", issued by Geology Survey Branch, Department of Mines and Energy, Government of Newfoundland and Labrador (Map 90-08) indicates that the Buchans Site geology consists of a blanket of diamicton or sand and gravel, 1.5 to 15 metres thick, having irregular hummocky topography and relief of 2 to 10 metres; hummocks are mainly composed of diamicton, but some contain poorly sorted sand and gravel; diamicton is of similar composition to the till veneer unit; bog is commonly found in low areas between hummocks; this unit was mainly deposited by ice disintegration and stagnation during deglaciation.

3.3 SITE CLASSIFICATION

For the purposes of this assessment and RMP, Public Areas were defined as parklands/recreational areas following the Canadian Council of Ministers (CCME) Guidelines.

4.0 FIELD ACTIVITIES

Based on a file review of available environmental documents pertaining to the Town and in consultation with the Province, a sampling program was developed to delineate previously confirmed lead concentrations in soil above the RBC. The northern section of Town was sub-divided into 8 Zones that were bounded by pre-existing geographical features such as roads, fences, etc. Soil investigations were then completed to assess environmental conditions in Public Areas.

CRA completed surficial soil sample collection activities, all of which were submitted to Maxxam Analytics Inc. (Maxxam) for chemical analyses of lead in soil. Specific details for the investigative activities completed by CRA are presented below.

4.1 BACKGROUND INVESTIGATION

The available soil quality data from the 2009 surficial soil sampling programs of the residential and Public Areas in the northern section of Town did not reveal a uniform concentration gradient that started at potential source areas, as would be expected if airborne dusting of the dry tailings were the only contributing factor. Some low concentration results were found within higher concentration areas in a difficult to decipher pattern, which may be due to a number of compounding factors. Low concentration results may have been caused by historical tilling of surface and sub-surface soil that diluted surface concentrations or importation of low lead containing soil for residential improvements from remote areas (i.e. topsoil or clean fill). High concentration results may have been a combination of airborne tailings dusting magnified further by the historical use of tailings and/or waste rock at selected locations for road building or backfill of low areas. These various factors may contribute to the appearance that soil test results on one property cannot be used to accurately represent the level of lead in soil on immediately adjacent properties.

In advance of and during the supplemental soil sampling program, CRA conducted some interviews with Town officials and local residents to determine historical mining company construction practices in the residential area of the northern part of Town. Very limited information was acquired with most indicating they were unaware of the source of fill material throughout this area; however, a few long-time residents indicated that crushed waste rock was used as gravel for many driveways. Consequently, it is assumed that waste rock was also used for other civil development works throughout the Town such as road building, fill material for leveling, etc.

4.2 FIELD METHODOLOGIES

Between June 23 and 29, 2010, CRA hand-excavated two surface soil sample locations that resulted in the collection of three samples from Public Areas. The following subsections provide information regarding the standard operating protocols followed by CRA for the surface soil sample collection program. Except as noted below, CRA collected the samples for this investigation in accordance with CRA's Standard Operating Procedures.

In addition, key features of the properties being sampled were also recorded to assist in the development of RMPs for each potential area that may require remedial effort in the future. A copy of the field notes are presented in Appendix A.

4.2.1 SURFICIAL SOIL SAMPLING

CRA collected composite surficial soil samples throughout previously identified Public Areas in the Town with a shovel or trowel. Samples were collected from immediately below a vegetative mat cover or from surface to a depth of 0.3 metres below ground surface (mbgs); however, one sample was collected from a sub-surface depth at 0.4 mbgs. All samples were placed in laboratory-supplied containers and delivered under chain-of-custody protocols to Maxxam.

4.2.2 SUMMARY OF FIELD ACTIVITIES

CRA collected a total of three soil samples from Public Areas. A complete summary of CRA's field activities is provided in Table 1 for soil samples. Figures 2.2A to 2.2H provide the locations for all samples collected.

The following table provides a summary of the field activities completed at Public Areas in each Zone for Buchans Site:

ZONE		TYPE OF INVESTIGATION	
Number	*Street Locations*	*Surface*	*Sub-Surface*
1	Jackson, Forebay, Market, Main, Gilchrist	-	-
2	William's Turnpike, Jackson, North, East, Church	-	-
3	North, Jackson, Main, William's Turnpike, Sleepy Valley, East, Church	-	-
4	Main, Water, Center, Prospect, West, Gilchrist, Court, tennis court, health care facility, community centre	2	1
5	Main, Center, South, Church, Jackson, Water	-	-
6	Main, Sleepy Valley, Church, South, Lake, William's Turnpike, MacLean, Water, swimming pool	-	-
7	South, Laycock, Walsh Memorial, Lundberg, Walwyn, Church	-	-
8	South, Lundberg, Walsh Memorial, Lakeview, Pine, playground	-	-

4.3 SURFICIAL GEOLOGY ENCOUNTERED

CRA noted surficial soils during the 2010 sampling program that consisted of densely packed sandy silt and gravel with some topsoil and sod or crushed stone for surface cover. Fill material was encountered at all 2010 sample locations, which only reached a maximum depth of 0.4 mbgs.

These findings were consistent with past ESA work completed by CRA in 2009 throughout and around the Town. The till, or native material, previously observed was comprised of silty sand, silty clay, sand and gravel, with some organic silt and peat.

5.0 APPLICABLE REGULATORY CRITERIA AND GUIDANCE

In order to assess the significance of the data and to aid in determining the scope of remediation and/or closure to be completed at each Zone, CRA compared the lead in soil data to the RBC developed in the CRA 2010 Summary HHRA report. The RBC was determined to be 622 mg/kg for lead in soil.

6.0 ANALYTICAL RESULTS

6.1 QA/QC

CRA received the analytical data from the laboratory through an electronic data deliverable. The first step in interpretation of the data was an examination of the quality control test results that included a review of blind field duplicates and original analytical results for general conformity to a Relative Percent Difference (RPD) target of 35 percent based on US EPA guidance document SOP#HW-2, Rev 13, September 2006. Laboratory replicate analyses were also reviewed against a 10 percent conformance standard. Quality Assurance/Quality Control (QA/QC) of the data was validated by CRA based on the laboratory Quality Control (QC) standard using the Certified Reference Material (CRM); therefore, the data was determined to be of acceptable quality and was used for interpretation.

All soil sample analytical results from the Public Areas reported QC standards of 105 percent for the two sets of analyses, both of which were within the conformance standard range of 90 to 110 percent. A copy of the Laboratory Certificate of Analysis is presented in Appendix B.

6.2 2009-2010 ANALYTICAL RESULTS DISCUSSION

CRA investigated 8 zones in the northern area of Town as shown on Figure 2. CRA combined the analytical data for samples collected from the CRA 2009 Phase II ESA, 2010 HHRA, and 2010 RMP. This section presents a discussion of all lead in soil analytical results for each Zone investigated in preparation for developing a RMP for the Public Areas. Analytical results from the 2010 soil sampling program are provided in Table 1 with all combined results for each Zone provided in Table 2.

Zone 1: Jackson-Forebay-Market-Main

Zone 1 is bounded to the northwest by Forebay Road and Market Street, to the south by Main Street, and to the east by Jackson Street along with Gilchrist Road contained within the boundaries noted above. Two Public Areas were identified in Zone 1 as follows:

- Z1-P1 – Veteran's Memorial at the intersection of Market Street and Main Street; and
- Z1-P2 – Ball field at the intersection of Forebay Road and Jackson Street.

In 2009, CRA collected two composite surface soil samples from two locations of interest (SS-03 at the Veteran's Memorial and SS-04 at the ball field) in Zone 1 as shown on Figure 2A. Additional samples were not collected in this Zone during the 2010 sampling program as the previous sampling efforts were considered adequate. The following table presents a summary of lead in soil analytical results at concentrations greater than the RBC criterion.

Parameter	*Criterion (mg/kg)*	*Number of Results Greater Than RBC Criterion*	*Minimum Result Greater Than Criterion (mg/kg)*	*Maximum Result Greater Than Criterion (mg/kg)*
Lead	622	2	780	1,200
Note: 2 soil samples in total were analyzed for lead.				

Zone 2: William's Turnpike-Jackson-North

Zone 2 is bounded to the east and north by William's Turnpike, to the west by Jackson Street, and to the south by North Street along with sections of East Street and Church Street contained within the above noted boundaries. Public Areas were not identified in Zone 2 as shown on Figure 2B.

Zone 3: North-Jackson-Main-William's Turnpike-Sleepy Valley

Zone 3 is bounded to the north by North Street, to the west by Jackson Street, to the south by Main Street, and to the east by William's Turnpike along with sections of East and Church Streets contained within above noted boundaries; this Zone also includes Sleepy Valley Place. Public Areas were not identified in Zone 3 as shown on Figure 2C.

Zone 4: Main-Water-Center

Zone 4 is bounded to the north by Main Street, to the west by Market Street, to the south by the extent of the tennis court, health care facility, and community centre, and to the east by Center Street along with sections of Prospect Street, West Street, Gilchrist Road, and Court Road contained within the above noted boundaries. Two Public Areas were identified in Zone 4 as follows:

- Z4-P1 – Tennis Court on Water Street; and
- Z4-P2 – Health care facility on Water Street.

In 2009, CRA collected four composite surface soil samples from four locations in Zone 4 (SS-01 west of the tennis court, SS-02 at the Museum, SS-19 at the health care facility courtyard, and RSS-06 at the curling rink) as shown on Figure 2D. Three additional samples were collected in 2010 (Z4-SS1 south of the tennis court and Z4-SS3 at the health care facility on Main Street) to provide some degree of delineation. In addition, one sub-surface sample (Z4-SS1-D at the same location as Z4-SS1) was collected at 0.4 mbgs. The following table presents a summary of lead in soil analytical results at concentrations greater than the RBC criterion.

Parameter	*Criterion (mg/kg)*	*Number of Results Greater Than RBC Criterion*	*Minimum Result Greater Than Criterion (mg/kg)*	*Maximum Result Greater Than Criterion (mg/kg)*
Lead	622	3	1,200	3,600
Note: 6 soil samples in total were analyzed for lead.				

Zone 5: Main-Center-South-Church

Zone 5 is bounded to the north by Main Street, to the west by Center Street, to the south by South Street, and to the east by Church Street along with sections of Jackson Street and Water Street contained within the above noted boundaries. Public Areas of interest were not identified in Zone 5 as shown on Figure 2E.

Zone 6: Main-Church-South-Lake-William's Turnpike

Zone 6 is bounded to the north by Main Street and Sleepy Valley Place, to the west by Church Street, to the south by South Street, and to the east by the school on Lake Road and the swimming pool on William's Turnpike along with sections of Lakeview Avenue, William's Turnpike, MacLean Street, and Water Street contained within the above noted boundaries. Two Public Areas were identified in Zone 6 as follows:

- Z6-P1 – Swimming pool on William's Turnpike; and
- Z6-P2 – School on Lake Road.

In 2009, CRA collected three composite surface soil samples from three locations in Zone 6 (SS-05 west of the swimming pool, SS-06 north of the school, and SS-08 east of the mini-golf) as shown on Figure 2F. Additional samples were not collected in this Zone during the 2010 sampling program as previous sampling efforts were considered

adequate. The following table presents a summary of lead in soil analytical results at concentrations greater than the RBC criterion.

Parameter	*Criterion (mg/kg)*	*Number of Results Greater Than RBC Criterion*	*Minimum Result Greater Than Criterion (mg/kg)*	*Maximum Result Greater Than Criterion (mg/kg)*
Lead	622	0	-	-
Note: 2 soil samples in total were analyzed for lead.				

Zone7: South-Laycock-Walsh Memorial-Lundberg

Zone 7 is bounded to the north by South Street, to the west by sheds on Laycock Street, to the south by sheds on Walsh Memorial Street, and to the east by Lundberg Avenue along with sections of Walwyn Street, Church Street, and Jackson Street contained within the above noted boundaries. Public Areas were not identified in Zone 7 as shown on Figure 2G.

Zone 8: South-Lundberg-Walsh Memorial-Lakeview

Zone 8 is bounded to the north by South Street, to the west by Lundberg Avenue, to the south by sheds on Walsh Memorial Street, and to the east by the playground on Lakeview Avenue along with sections of Lakeview Avenue and Pine Street contained within the above noted boundaries. One Public Area of interest was identified in Zone 8 as follows:

- Z8-P1 – Playground on Lakeview Avenue.

In 2009, CRA collected one composite surface soil sample in Zone 8 (SS-07 at the playground) as shown on Figure 2H. Additional samples were not collected in this Zone during the 2010 sampling program as the previous sampling efforts were considered adequate. The following table presents a summary of lead in soil analytical results at concentrations greater than the RBC criterion.

Parameter	*Criterion (mg/kg)*	*Number of Results Greater Than RBC Criterion*	*Minimum Result Greater Than Criterion (mg/kg)*	*Maximum Result Greater Than Criterion (mg/kg)*
Lead	622	0	-	-
Note: 1 soil sample in total was analyzed for lead.				

7.0 SUMMARY OF LEAD IMPACTED SOIL IN PUBLIC AREAS

The following table presents a summary of the impacted surface soils by Zone in each location with areas of impacted lead in soil concentrations that exceeded the RBC criterion, which were determined based on sample results presented in Section 6.0.

Zone		*Net Area*	*Lead Concentrations*
Number	*Location*	*(m^2)*	*Soil (mg/kg)*
1	Veteran's Memorial	4,000	1,200
1	Ball field	7,500	780
4	Tennis Court area, west side	2,250	1,500
4	Tennis Court area, south side	1,100	3,600 – 4,500
4	Health care facility courtyard, south side	1,650	1,200

The following basic formula was used to calculate the Net Area to be addressed by the RMP:

$$An = RAF * (Ag - Ab)$$

where:

An: Net Area
RAF: Factor to allow for a reduced surface area based on ancillary buildings (i.e. sheds), walkways, driveways, large trees, etc.; ranged from 0.4 to 4.4 % of Ag
Ag: Gross Area of the impacted location contained within geographical boundaries
Ab: Building Area addresses any larger structures on the location

Net area calculations are presented in Table 3.

Impacts to Public Areas were not identified in the following Zones:

- Zone 2 – William's Turnpike, Jackson, North
- Zone 3 – North, Jackson, Main, William's Turnpike, Sleepy Valley
- Zone 5 – Main, Center, South, Church
- Zone 6 – Main, Church, South, Lake, William's Turnpike
- Zone 7 – South, Laycock, Walsh Memorial, Lundberg
- Zone 8 – South, Lundberg, Walsh Memorial, Lakeview

8.0 RISK MANAGEMENT

8.1 RISK ASSESSMENT

An HHRA estimates potential cancer and non-cancer health impacts from exposure to chemicals of potential concern. These estimates are based on methods, calculations, and input assumptions developed by regulatory agencies. The HHRA was conducted using surface soil data obtained from sampling conducted in the Public and Residential Areas of Town in 2009. CRA screened the metals data by comparing the maximum concentrations detected in the August and October 2009 surface soil samples to generic residential soil screening criteria developed by federal and provincial agencies to determine the MOIs.

The HHRA developed site-specific RBCs and subsequently evaluated the significance of metals concentrations by first examining potential pathways by which individuals may come in contact with surface soil in the Town. In this case, the potential pathways that could lead to exposure included the following:

- *Potential Source of Metals* – TSA and exposed tailings around existing tailings ponds and soils around the Town;
- *Release of Mechanism* – Airborne particulate dust dispersion or waste rock from mining operations;
- *Media of Concern* – Surface soil in Town;
- *Receptors* – Adults and children, with children being identified as the most sensitive receptors for non-carcinogens such as lead; and
- *Exposure Routes* – Incidental ingestion, direct dermal contact, and dust inhalation

The intent of this RMP is to mitigate exposure to lead impacted soil, i.e. remove the potential to be in direct contact with the soil to remove the risk of exposure.

8.2 RISK MANAGEMENT ALTERNATIVES

Risk management alternatives are directly influenced by such factors as existing property usage (playground, parking lot, etc.), exposure scenarios based on dermal contact limited by surface cover (grass, gravel, asphalt, concrete, etc.) or construction activities (disturbing surface or sub-surface soil), and costs associated with each alternative. In an effort to mitigate lead in soil exceedances reported from the 2009 and 2010 surface soil sampling programs at Public Areas in the Town, CRA considered potential alternatives during the development of this RMP as summarized below.

- Restrict usage to limit exposures and/or use of the Public Areas by directing users to wear appropriate personal protective equipment (PPE), thereby blocking potential dermal contact;
- Import and placement of clean imported soil over the existing surfaces followed by reinstatement of landscaping;
- Removal of lead impacted soil with disposal at an approved waste disposal site, import and place clean soil with reinstatement of landscaping; and
- Any combination of the previously listed options.

Additional discussion is presented below. Estimated unit price costs associated with each alternative are provided under separate cover.

8.2.1 RESTRICTED USAGE

Restricted usage to the public of Public Areas is a contradictory solution and was not considered as a socially viable alternative; therefore, further discussion is not presented regarding this option.

8.2.2 IMPORT AND PLACE CLEAN FILL

This option is based on the assumption that existing soil and landscaped surfaces remain intact; however, clean imported topsoil with finished landscaping would be required to establish an adequate barrier between lead impacted soil and the surface. Since these are Public Areas, 0.15 metres of clean fill material will be adequate to establish a cover barrier as sub-surface soils below the clean fill will likely not be disturbed by users.

Importation and placement of clean fill over existing lead impacted soils has the advantage of eliminating any need for impacted soil disposal considerations and eliminates the need for removal, replacement, and trucking. Disadvantages include the requirement for a raised elevation of finished landscaped surfaces that may not be complimentary to fixed features such as sidewalks, steps, curbs, fencing, flower beds, shrubs, trees, etc.

8.2.3 REPLACEMENT OF LEAD IMPACTED SOIL

The third option involves removal of lead impacted soil and vegetative surface covering (i.e. sod) and replacement with clean imported soil and finished landscaping. The same assumption applies in this alternative that 0.15 metres of clean fill material will be

adequate to establish a cover barrier as sub-surface soils below the clean fill will likely not be disturbed by users.

Removal of impacted soil and replacement with clean fill and finished landscaping has the advantage of maintaining previously established surface elevations. Disadvantages include the need for removal, replacement, and trucking of impacted soil, handling and re-planting of any shrubs or flower beds in the affected area, and completion of finished landscaping that may include sods, concrete/asphalt/gravel walkways, fencing, etc. It is assumed that lead-impacted soil will be disposed of at a location near the Town rather than transported off the island to a registered disposal facility on the mainland.

8.2.4 IMPORT CLEAN FILL AND/OR REPLACE LEAD IMPACTED SOIL

The final option considered involves a combined approach of placing clean imported fill over lead impacted soil at select sites and/or removal of lead impacted soil with vegetative surface covering (i.e. sod) and replacement with clean imported soil and finished landscaping at the remaining sites. The same assumption applies in this alternative that 0.15 metres of clean fill material will be adequate to establish a cover barrier as sub-surface soils below the clean fill will likely not be disturbed by users.

Placement of clean imported fill material may be a favourable alternative in areas where raising the surface elevation is not an issue (i.e. ball field, tennis court surrounding areas). Other areas where an increased surface elevation is an issue can be addressed by removal of impacted soil and replacement with clean fill and finished landscaping. This alternative has the advantage optimizing the two remedial approaches to maximize cost and time efficiencies. It is assumed that lead-impacted soil will be disposed of at a location near the Town rather than transported off the island to a registered disposal facility on the mainland.

8.2.5 SUMMARY OF RISK MANAGEMENT ALTERNATIVES

A variety of landscaped surfaces currently exist at the various public locations where RMPs are required. For example, the ball field has a sand infield, sodded outfield, and gravel area outside the playing field. Therefore, the type of finished landscaping will be driven by existing conditions and the Town, since they will be the end user responsible for maintenance of these areas.

The estimated costs were derived from similar work that CRA completed in New Brunswick as well as recent civil works completed in Buchans, NL during the 2010 construction season. A slight allowance for inflation (5 percent) was also included to account for an extended remedial plan that may be completed in stages.

9.0 RECOMMENDATIONS

A number of factors were considered in developing a preferred RMP for each of the four Public Areas addressed herein. Firstly, the type of remedial control measure was greatly influenced by existing landscaping finishes. The second issue of consideration related to the priority of completing the remedial work based on a review of potential exposure through dermal contact for one location in comparison to others within the group of Public Areas that were scrutinized.

9.1 PROPOSED RISK MANAGEMENT ALTERNATIVES

As noted above, the proposed risk management alternatives were influenced by a variety of factors. Additional information is provided within this Section to further detail how the proposed alternative was determined for each Public Area based on Zonal boundaries. Zones without Public Areas of concern included Zones 2, 3, and 5 to 7; therefore, a discussion regarding these areas was not included below.

Estimates for proposed remedial alternatives are provided under separate cover

9.1.1 ZONE 1 – PUBLIC AREA 1: VETERAN'S MEMORIAL

The Veteran's Memorial, located northeast of the intersection of Market Street and Water Street, is predominantly covered with gravel, sparse vegetation, and concrete walkways. The potential for public exposure is low for this area since this location is only used intermittently throughout the year for public gatherings; however, the potential does exist that children could play at this location. Placement of new fill material over the existing landscaped surfaces will result in increased elevations compared to surrounding fixed municipal works (such as sidewalks, road shoulders, etc.) and structures on the Site (walkways, monument, trees, shrubs).

Based on the existing Site conditions, it is recommended that removal of the top 0.3 metres of soil and sod, all of which should be disposed of at a lead-impacted soil disposal facility approved by the Province. Reinstatement would include the supply and placement of 0.15 metres of clean fill, then 0.15 metres of clean topsoil, followed by installation of sods. Note that concrete walkways and the memorial concrete foundation would not require removal or replacement unless damaged by the work. Particular attention will be required when working around shrubs and trees to prevent excessive root damage during the remedial work. In addition, maintenance care will be required

for 60 days following sod placement (and shrubbery replanting, if required) to ensure adequate root regrowth is established.

9.1.2 ZONE 1 – PUBLIC AREA 2: BALL FIELD

The ball field, located southwest of the intersection of Jackson Street and Forebay Road, is predominantly covered with a sand infield, gravel outfield, and gravel areas outside the ball field fenced areas. The potential for public exposure is in this area is very high due to the use of the facility by children and adults alike. Placement of new fill material over the existing surfaces is a viable option as this will not result in increased surface elevations compared to surrounding fixed municipal works or structures on the Site with the exception of fencing; therefore, fence posts would require replacement with new posts (only pertains to the outfield and both foul line fencing).

Based on the existing Site conditions, it is recommended that supply and placement of 0.15 metres of clean fill inside the fenced area of the ball field, then 0.15 metres of clean sand on the infield and Class "A" material on the outfield. Clean fill material could also be placed over the areas immediately outside the fenced ball field that would typically be exposed to vehicular or foot traffic during any sporting events at this facility. As noted above, fence posts for the outfield and foul lines would require replacement.

9.1.3 ZONE 4 – PUBLIC AREA 1: TENNIS COURT

The Public Area that contains the Tennis Court, located south of Water Street at the west end of Town, is covered with asphalt; however, the surrounding areas used for parking and foot traffic are covered with gravel and/or fill material. The potential for public exposure is high for this area since this location is frequently used seasonally by adults and children. In addition, the lack of surface cover material in the surrounding areas allows wind-blown dust to circulate in the air around the Tennis Court.

Placement of new fill material over the existing surfaces at the Tennis Court will result in increased elevations compared to surrounding fixed municipal works (such as road shoulders and Water Street) along with the primary on-Site sports facility (Tennis Court). Increased surface elevations would create a negative grade or bowl effect around the Tennis Court that would interfere with drainage of ponding water from the surface of the court.

Based on the existing Site conditions around the Tennis Court, it is recommended that removal of the top 0.3 metres of soil and disposed of at a lead-impacted soil disposal facility approved by the Province. Reinstatement would include the supply and placement of 0.15 metres of clean fill, then 0.15 metres of Class "A".

9.1.4 ZONE 4 – PUBLIC AREA 2: HEALTH CARE CENTRE

The Public Area that contains the A.M. Guy Memorial Health Care facility, located south of Water Street, has an area of interest on the south side courtyard and is predominately covered by vegetation, concrete walkways, shrubs, and trees. The potential for public exposure is low for this area since it is typically used by seniors residing at the Health Care Centre; however, the potential exists that children could play at this location.

Placement of new fill material over the existing landscaped surfaces at the south side courtyard of the Health Care Centre will result in increased elevations compared to surrounding fixed municipal works (such as road shoulders) along with on-Site features (entry steps to the Site building, walkways, shrubs, trees, etc.).

Based on the existing Site conditions at the south side of the Health Care Centre, it is recommended that removal of the top 0.3 metres of soil and sod, all of which must be disposed of at a lead-impacted soil disposal facility approved by the Province. Reinstatement would include the supply and placement of 0.15 metres of clean fill followed by 0.15 metres of clean topsoil and sod. Note that walkways would not require removal or replacement unless damaged by the work. Particular attention will be required when working around shrubs and trees to prevent excessive root damage during the remedial work. In addition, maintenance care will be required for 60 days following sod placement (and shrubbery replanting, if required) to ensure adequate root regrowth is established.

9.2 PRIORITIZATION OF PUBLIC AREA REMEDIATION

As described above in Section 9.1, four primary areas of concern were identified through the 2009 and 2010 surficial soil sampling programs conducted in Public Areas. These areas were further investigated to determine type of existing surface cover that could act as barriers to lead-impacted soil, exposure potential to adults and/or children along with duration of exposures. Based on the information presented, the table below summarizes the Zone, Public Area, location, and priority level allocated to each area of concern.

Zone		Priority
Number	*Location*	
1	Veteran's Memorial	Low
1	Ball field	High
4	Tennis Court area, west side	High
4	Tennis Court area, south side	High
4	Health care facility courtyard, south side	Low

CRA recommend that the preferred remedial options be implemented to address High priority Public Areas first.

A summary of the proposed remedial alternatives described above is presented under separate cover.

9.3 OTHER ISSUES OF CONCERN

Several risk management alternatives include the removal and disposal of lead-impacted soil at a disposal facility approved by the Province. At the time of writing this report, a soil disposal facility does not exist that is approved by the Province for disposal of lead impacted soil; therefore, all lead impacted soil being removed from areas within the Town would require transportation to a facility off the island for disposal. This approach would result in extremely high disposal costs that would render such a remedial alternative as economically unfeasible.

CRA recommend that lead-impacted soil removed from Public Areas in the Town should be disposed of at a location determined by the Province and the Town that would be nearby Buchans. Such an alternative would require an engineered facility that would meet the same construction criteria as that recently completed for the TSA in 2010. An added benefit to nearby disposal is that completion time for construction activities would be dramatically reduced compared to off-island disposal.

An estimated cost to construct an engineered landfill to accommodate the lead-impacted soil from the Public Areas is provided under separate cover. The costs were based on the tendered unit price costs from the engineered landfill construction work completed at the TSA in 2010.

10.0 REFERENCES

Report entitled "Environmental Site Assessment, Abitibi-Consolidated Inc. – Buchans Mine Site, Buchans, Newfoundland" submitted to Weirfoulds, LLP and the Province of Newfoundland and Labrador, prepared by CRA, dated November 2009.

Report entitled "Human Health Risk Assessment, Town of Buchans, Newfoundland and Labrador" submitted to the Province of Newfoundland and Labrador, prepared by CRA, dated March 2010.

Report entitled "Summary Report, Human Health Risk Assessment, Town of Buchans, Newfoundland and Labrador" submitted to the Province of Newfoundland and Labrador, prepared by CRA, dated March 2010.

figure 2

AERIAL SITE PLAN
RISK MANAGEMENT PLAN FOR PUBLIC AREAS
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
Buchans, NL

figure 2A

AERIAL SITE PLAN WITH SAMPLE LOCATIONS - ZONE 1
RISK MANAGEMENT PLAN FOR PUBLIC AREAS
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
Buchans, NL

070854(004)GN-DA02A DECEMBER 20/2010

figure 2B

AERIAL SITE PLAN WITH SAMPLE LOCATIONS - ZONE 2
RISK MANAGEMENT PLAN FOR PUBLIC AREAS
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
Buchans, NL

070854(004)GN-DA02B DECEMBER 20/2010

figure 2C

AERIAL SITE PLAN WITH SAMPLE LOCATIONS - ZONE 3
RISK MANAGEMENT PLAN FOR PUBLIC AREAS
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
Buchans, NL

070854(004)GN-DA02C DECEMBER 20/2010

N

0 15 30 45m

SCALE:1:1,500

LEGEND

- ZONE BOUNDARIES
- REMEDIATION ZONE BOUNDARIES
- PUBLIC RECREATIONAL AREAS SURFICIAL SOIL SAMPLE (CRA 2009)
- SOIL SAMPLE LOCATION (CRA 2010)
- SURFICAL SOIL SAMPLE (CRA 2009) (LEAD CONCENTRATIONS EXCEEDING RISK MANAGEMENT PLAN RISK-BASED CONCENTRATION (622mg/kg) ARE NOTED)

RISK MANAGEMENT PLAN
RISK-BASED CONCENTRATION
LEAD - 622 mg/kg

MAIN STREET
CENTER STREET
PROSPECT STREET
WEST STREET
GILCHRIST ROAD
COURT ROAD
MARKET STREET
WATER STREET
RED OCHRE INN
MUSEUM
TENNIS COURT
A.M. GUY MEMORIAL HEALTH CENTRE
CURLING ARENA
COMM. CENTRE

Z4-P3
SS-02
RSS-06
SS-19
LEAD: 1200 mg/kg
Z4-SS3
Z4-P2
SS-01
LEAD: 1500 mg/kg
Z4-P1
Z4-SS1D
LEAD: 4500 mg/kg
Z4-SS1
LEAD: 3600 mg/kg

figure 2D

AERIAL SITE PLAN WITH SAMPLE LOCATIONS - ZONE 4
RISK MANAGEMENT PLAN FOR PUBLIC AREAS
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
Buchans, NL

070854(004)GN-DA02D DECEMBER 20/2010

figure 2E

AERIAL SITE PLAN WITH SAMPLE LOCATIONS - ZONE 5
RISK MANAGEMENT PLAN FOR PUBLIC AREAS
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
Buchans, NL

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figure 2F

AERIAL SITE PLAN WITH SAMPLE LOCATIONS - ZONE 6
RISK MANAGEMENT PLAN FOR PUBLIC AREAS
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
Buchans, NL

figure 2G

AERIAL SITE PLAN WITH SAMPLE LOCATIONS - ZONE 7
RISK MANAGEMENT PLAN FOR PUBLIC AREAS
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
Buchans, NL

figure 2H

AERIAL SITE PLAN WITH SAMPLE LOCATIONS - ZONE 8
RISK MANAGEMENT PLAN FOR PUBLIC AREAS
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
Buchans, NL

070854(004)GN-DA02H DECEMBER 20/2010

TABLE 1

SOIL ANALYTICAL RESULTS
AVAILABLE LEAD (mg/kg)
BUCHANS, NL

Zone	Sample ID	Date	Depth (m)	Lead	Comments [1]	
					Imported Fill/Soil	Potential Mine Waste
1	**-**	-	-	-	-	-
2	**-**	-	-	-	-	-
3	**-**	-	-	-	-	-
4	**Z4-SS1**	Jun 26, 2010	0.1	**3,600**	n/a	n/a
	Z4-SS01-D	Jun 26, 2010	0.3	**4,500**	n/a	n/a
	Z4-SS3	Jun 26, 2010	0.1	290	n/a	n/a
5	**-**	-	-	-	-	-
6	**-**	-	-	-	-	-
7	**-**	-	-	-	-	-
8	**-**	-	-	-	**-**	-
Site-Specific Risk-Based Concentration in Soil [2]				**622**	-	-

NOTES 1 - Comments based on field observations and/or interviews
2 - Developed by CRA in the Human Health Risk Assessment Report dated March 2010
n/a- Information not available from resident

TABLE 2

HISTORICAL SOIL ANALYTICAL RESULTS
AVILABLE LEAD (mg/kg)
RISK MANAGEMENT PLANS FOR PUBLIC AREAS
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
BUCHANS, NL

Zone	Sample ID	Date	Depth (m)	Lead	Comments [1]	
					Imported fill/soil	Potential mine waste
1	**RSS-01**	Aug 31, 2009	0.3	**1,100**	n/a	n/a
	SS-03*	Oct 12, 2009	0.1	**1,200**	n/a	n/a
	SS-04*	Oct 12, 2009	0.1	**780**	n/a	n/a
2	**-**	-	-	-	-	-
3	**-**	-	-	-	-	-
4	**RSS-06**	Aug 31, 2009	0.3	470	n/a	n/a
	SS-01*	Oct 12, 2009	0.1	**1,500**	n/a	n/a
	SS-02*	Oct 12, 2009	0.1	210	n/a	n/a
	SS-19*	Oct 13, 2009	0.1	**1,200**	n/a	n/a
	Z4-SS1	Jun 26, 2010	0.1	**3,600**	n/a	Y
	Z4-SS01-D	Jun 26, 2010	0.3	**4,500**	n/a	Y
	Z4-SS3	Jun 26, 2010	0.1	290	n/a	n/a
5	**-**	-	-	-	-	-
6	**SS-05***	Oct 12, 2009	0.1	350	n/a	n/a
	SS-06*	Oct 12, 2009	0.1	220	n/a	n/a
	SS-06 (Lab Dup)*	Oct 12, 2009	0.1	250	n/a	n/a
	SS-08*	Oct 12, 2009	0.1	270	n/a	n/a
7	**-**	-	-	-	-	-
8	**SS-07***	Oct 12, 2009	0.1	84	n/a	n/a
Site-Specific Risk-Based Concentration in Soil [2]				**622**	-	-

NOTES 1 - Comments based on field observations and property occupants
2 - Developed by CRA in the Human Health Risk Assessment Report dated March 2010
n/a- Information not available from resident
*- Public area; therefore, no survey completed

TABLE 3

NET AREA CALCULATIONS OF LEAD IN SOIL
RISK MANAGEMENT PLAN FOR PUBLIC AREAS
BUCHANS, NL

ZONE	PUBLIC AREA	GENERAL LOCATION	GROSS AREA	BUILDING FOOTPRINTS	AREA WITHOUT BUILDINGS	REDUCTION ADJUSTMENT FACTOR	NET AREA
1	1	Veteran's Memorial	4,225	0	4,225	5	4,014
	2	Ball Field	7,475	0	7,475	0	7,475
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
4	1	Tennis Court	5,600	2,275	3,325	0	3,325
	2	Health Care Centre	1,825	0	1,825	10	1,643
5	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-

NOTES Gross Area = Gross Public Area of Outlined Lead Impacted Surface Soils
Building Footprints = Approximate Building Footprint Area
Area Without Buildings = Difference of Gross Area and Building Footprint
Reduction Adjustment Factor = Allowance for Area Reduction Based on Ancillary Buildings (Sheds), Walkways, Driveways, Large
Net Area = Difference of Gross Area and Building Footprints Reduced by the Reduction Adjustment Factor

DEPTH OF REMOVAL 0.3 metres below ground surface

TABLE 4

ESTIMATED REMEDIAL COSTS
RISK MANAGEMENT PLAN FOR PUBLIC AREAS
BUCHANS, NL

ZONE	PUBLIC AREA	GENERAL LOCATION	NET AREA	UNIT RATES										PUBLIC AREA ZONAL ESTIMATES
				EXCAVATE LEAD IMPACTED SOIL	TRANSPORT/ DISPOSAL	* MISC ALLOWANCE	DELIVERY, COMPACTION 0.15m SOIL	DELIVERY , PLACEMENT 0.15m TOPSOIL	DELIVERY, PLACEMENT 0.15m SAND	DELIVERY, PLACEMENT 0.15m CLASS A	DELIVERY, PLACEMENT HYDROSEED	DELIVERY, PLACEMENT SOD	SUB-TOTAL	
				$10	$20		$15	$6	$25	$25	$1	$7		
1	1	Veteran's Memorial	4,014	$40,138	$48,165	$5,000	$60,206	$24,083	-	-	-	$28,096	$205,688	$498,614
	2	Ball Field	7,475	-	-	-	$112,125	$33,638	$7,008	$140,156	-	-	$292,927	
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	1	Tennis Court	3,325	$33,250	$39,900	$500	$49,875	-	-	$83,125	-	-	$206,650	$255,159
	2	Health Care Centre	1,643	$3,285	$3,942	$1,000	$24,638	$7,391	$1,540	$3,080	$1,335	$2,300	$48,509	
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-

NOTES Gross Area = Gross Public Area of Outlined Lead Impacted Surface Soils
Building Footprints = Approximate Building Footprint Area
Area Without Buildings = Difference of Gross Area and Building Footprint
Reduction Adjustment Factor = Allowance for Area Reduction Based on Ancillary Buildings (Sheds), Walkways, Driveways, Large Trees, etc.
Net Area = Difference of Gross Area and Building Footprints Reduced by the Reduction Adjustment Factor

DEPTH OF REMOVAL 0.3

* Includes shrub replanting, securing trees, fence adjustments, etc.

TABLE 5

SUMMARY OF ESTIMATED REMEDIAL COSTS
RISK MANAGEMENT PLAN FOR PUBLIC AREAS
BUCHANS, NL

ZONE	AREA	GENERAL LOCATION	NET AREA	AREA SUB-TOTAL	ZONAL SUB-TOTALS
1	PUB 1	Veteran's Memorial	4,014	$205,688	$498,614
	PUB 2	Ball Field	7,475	$292,927	
2	-	NA	-	-	-
3	-	NA	-	-	-
4	PUB 1	Tennis Court	3,325	$206,650	$255,159
	PUB 2	Health Care Centre	1,643	$48,509	
5	-	NA	-	-	-
6	-	NA	-	-	-
7	-	NA	-	-	-
8	-	NA	-	-	-
				$753,773	

Sub-Total	$753,773
Mob/Demob (5%)	$37,689
Traffic Control	$25,000
Contingency (5%)	$39,573
Engineering Fees (11%)	$94,164
	$950,199

NOTES Net Area = Difference of Gross Area and Building Footprints Reduced by the Reduction Adjustment Factor

2,694 m^3 estimated of lead impacted soil
OR
5,389 tonnes

Local landfill const	$156,764
Engineering Fees (15%)	$23,515
	$180,278

TOTAL ESTIMATED COST $1,130,477

APPENDIX A

FIELD NOTES

24-551

BACK SIDE OF TENNIS COURT (South)

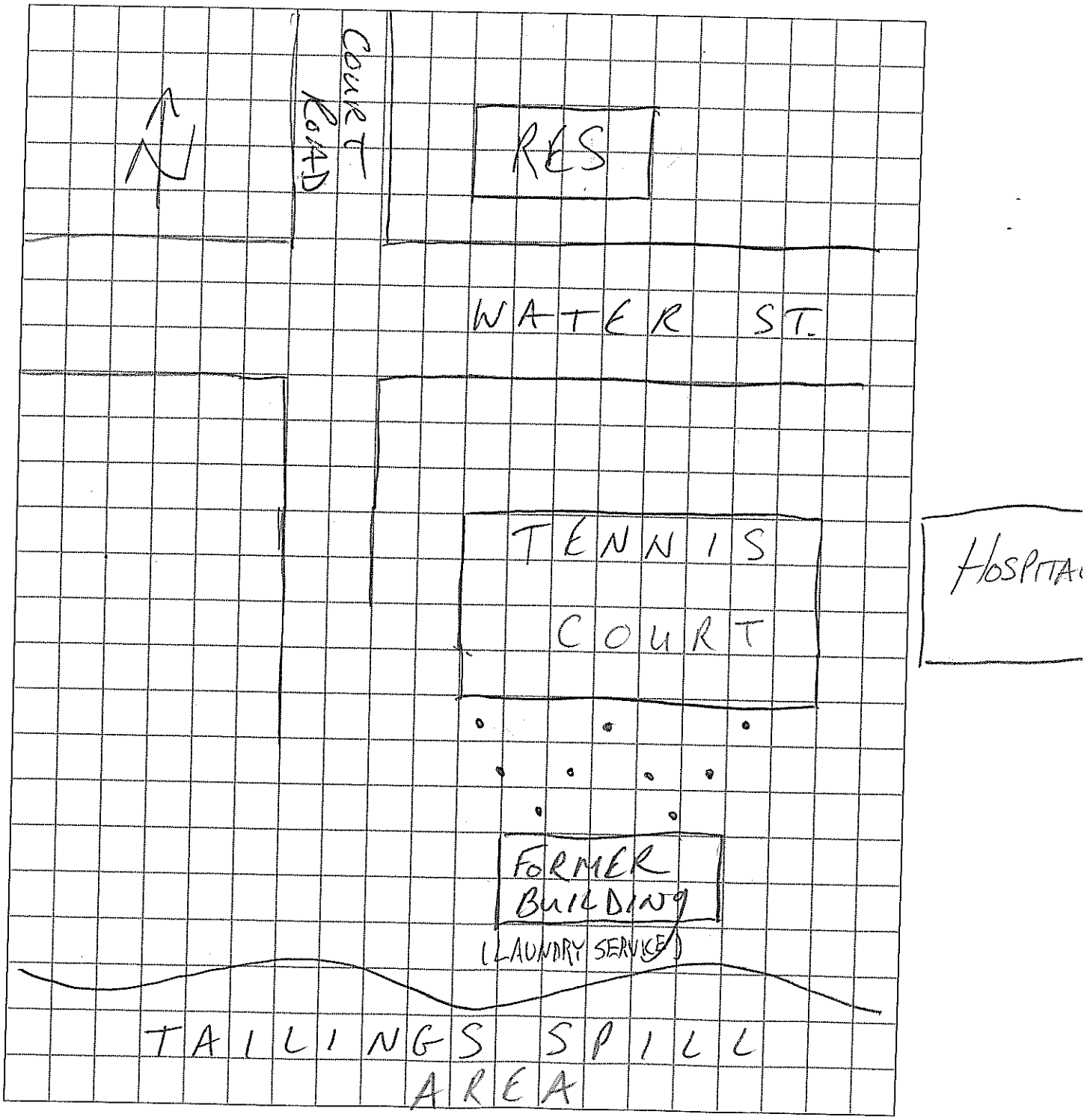
Buchcans Residential & Public Areas Soil Study
Project Number: 070854

- No Survey - Public Area.
- Were told by local that former building was a former laundry service for hospital

Form 3 **(Page 1 of 1)**

SITE PLAN (Show scale or rough measurements)

(Show north arrow, name of street frontage, house/building, outbuildings, road, driveway, garden(s), play structures, decks, electric utility poles, sidewalks, wells, sewers, ditches, storm drains, oil tanks, fill locations, topsoil locations, sub-sample locations, nearby landforms and structures, and direction and number of each photo)



24-551

Buchcans Residential & Public Areas Soil Study
Project Number: 070854

Form 4

FIELD DATA (Complete one form per sample location)

Date: June 26/2010 Time in: 8:00 AM Time out: 8:30 AM Team: S. Forward, C. Smith, P. Gillingham

Temperature: 16°C Weather Conditions: Sunny, clear

Owner notified of team arrival/departure: ☐ Yes ☑ No (left card) If no, why? Public Sample ID: Z4 - SS1

Observations	Sample Intervals
	0-5cm
Any vegetation present?	No
Vegetation/grass cover removed for sampling?	No
Staining/odours present?	No
Visual appearance and texture of soil	Crushed stone cover with sandy silt + gravel @ sample depth. Possible tailings in fill. Dark brown to black in colour. Mois.
Approximate depth range of all sub-sample collected	

Description of any problems encountered during sampling: 4 locations very densely packed

Description of any features that could influence soil chemistry (1): Use of tailings as fill
Fencing along south boundary

☑ Photos taken of sample location and any features of the location that could influence soil chemistry. Indicate all photo locations and directions on site plan (Form 3).

(1) i.e. compaction (heavy vehicles), backyard construction area, auto servicing area, metal clothes hanging structures, heavily fertilized/manicured lawn, unusual vegetation appearance, etc.

24-SS-01-D

NO Survey- Samples collected in 2009, CRA 2010 collected deep samples in the same location

Buchcans Residential & Public Areas Soil Study
Project Number: 070854

Form 4

FIELD DATA (Complete one form per sample location)

Date: June 26/10 Time in: 8:50 AM Time out: 9:30 AM Team: C. Smith, S. Forward, J. Gillingham

Temperature: 16°C Weather Conditions: Clear + Sunny

Owner notified of team arrival/departure: ☐ Yes ☑ No (left card) If no, why? Public Area Sample ID: 24-SS-01-D

Observations	Sample Intervals
	0-5cm
Any vegetation present?	No
Vegetation/grass cover removed for sampling?	No
Staining/odours present?	Yellow-Orange surface staining
Visual appearance and texture of soil	Compact gravel fill with sand. Orange staining @ sample depth. Metallic particulate @ 1 sample loc^.
Approximate depth range of all sub-sample collected	25-30 cm

Description of any problems encountered during sampling: None

Description of any features that could influence soil chemistry (1): Fencing + imported fill

☑ Photos taken of sample location and any features of the location that could influence soil chemistry. Indicate all photo locations and directions on site plan (Form 3).

(1) i.e. compaction (heavy vehicles), backyard construction area, auto servicing area, metal clothes hanging structures, heavily fertilized/manicured lawn, unusual vegetation appearance, etc.

TENNIS COURT (WEST SIDE) 24-55-01-D

1500 lpm

58704-80 10/12/09

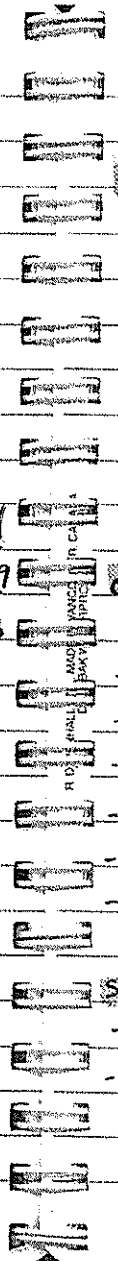
S-58704-101209-CH-001

- upwind (W) of tennis court

- GPS pts: WP# Easting Northing (UTM 21U)

WP#	Easting	Northing
48	510327	5407836
49	510338	5407800
50	510320	5407808
~~51~~	~~510313~~	~~5407815~~ CH
52	510317	5407820
53	510333	5407819
54	510328	5407806
center of 55	510324	5407814
56	510328	5407818
57	510324	5407827

- pt 1: sandy silt and gravel cover
- crushed stone, possibly from the mill
- pic #1: looking E at tennis court
- pic #2: " E at pt #5; note yellow crushed stone/tailings stone colour
- pic #3: looking W from ~~the~~ edge of tennis court
- pic #4: mine tailings in surficial soils



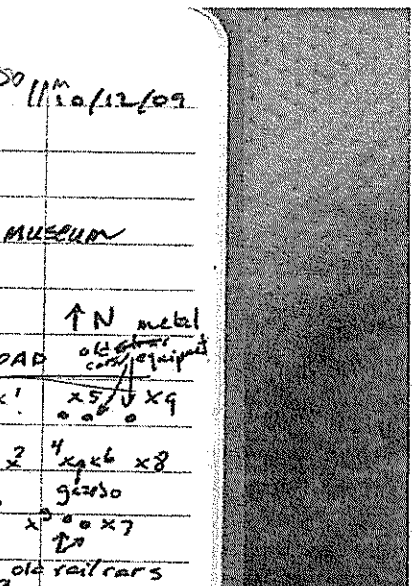
58704-80 <550 11m 10/12/09

S-58704-101209-CH-002

- museum park - Buchans miners museum

- GPS:

WP#	Easting	Northing
58	510326	5407954
59	510341	5407957
60	510356	5407962
61	510353	5407955
62	510356	5407942
63	510349	5407943
center of 64	510342	5407946
65	510342	5407936



- soil: topsoil w/ trace sandy silt and gravel
- pic #5: looking E at museum park
- pic #6: looking SW at " "
- pic #7: " W at museum bldg.
- pic #8: composite sample before mixing
- possible trace of tailings

S-58704-101209-CH-003 1:200 pm

- Memorial park located N of Red ochre Inn.

- GPS

WP#	Easting	Northing
66	510219	5407933
67	510211	5407954

69
LEVEL

58704-80

OCTOBER 12, 2009

CRA: C. HEIJ, E. GILBERT

EVENT: CHARACTERIZATION SURFICIAL SOIL SAMPLES

LOCATION: PUBLIC ACCESS LOCATIONS, BUCHANS, NFLD

H+S: MOD. LEVEL D

WEATHER: COLD, PARTLY CLOUDY, WIND NW

ANALYSIS: METALS, BIOAVAILABILITY

0830 - CRA ON-SITE

1120 - CRA BEGIN COLLECTION OF COMPOSITE CHARACTERIZATION SOIL SAMPLES FROM PUBLIC ACCESS AREAS IN BUCHANS, NFLD. SOIL SAMPLES COLLECTED AS 9-POINT COMPOSITES, EACH COMPOSITE LOCATION COLLECTED 0-4" BGS TO TOP LAYER SOD AND ROOTS REMOVED WHEN ENCOUNTERED. SAMPLES ANALYZED FOR METALS, BIOAVAILABILITY.

- SAMPLE SUMMARY

ID	TIME	COMMENTS
S-58704-101209-CH-001	11:20	9-PT COMP TENNIS COURT
-002	11:50	BUCHANS MINERS MUSEUM - PARK
-003	13:00	MEMORIAL PARK - IN FRONT OF INN (N)
-004	13:30	BASEBALL DIAMONDS

17

LEVEL

No survey - public area

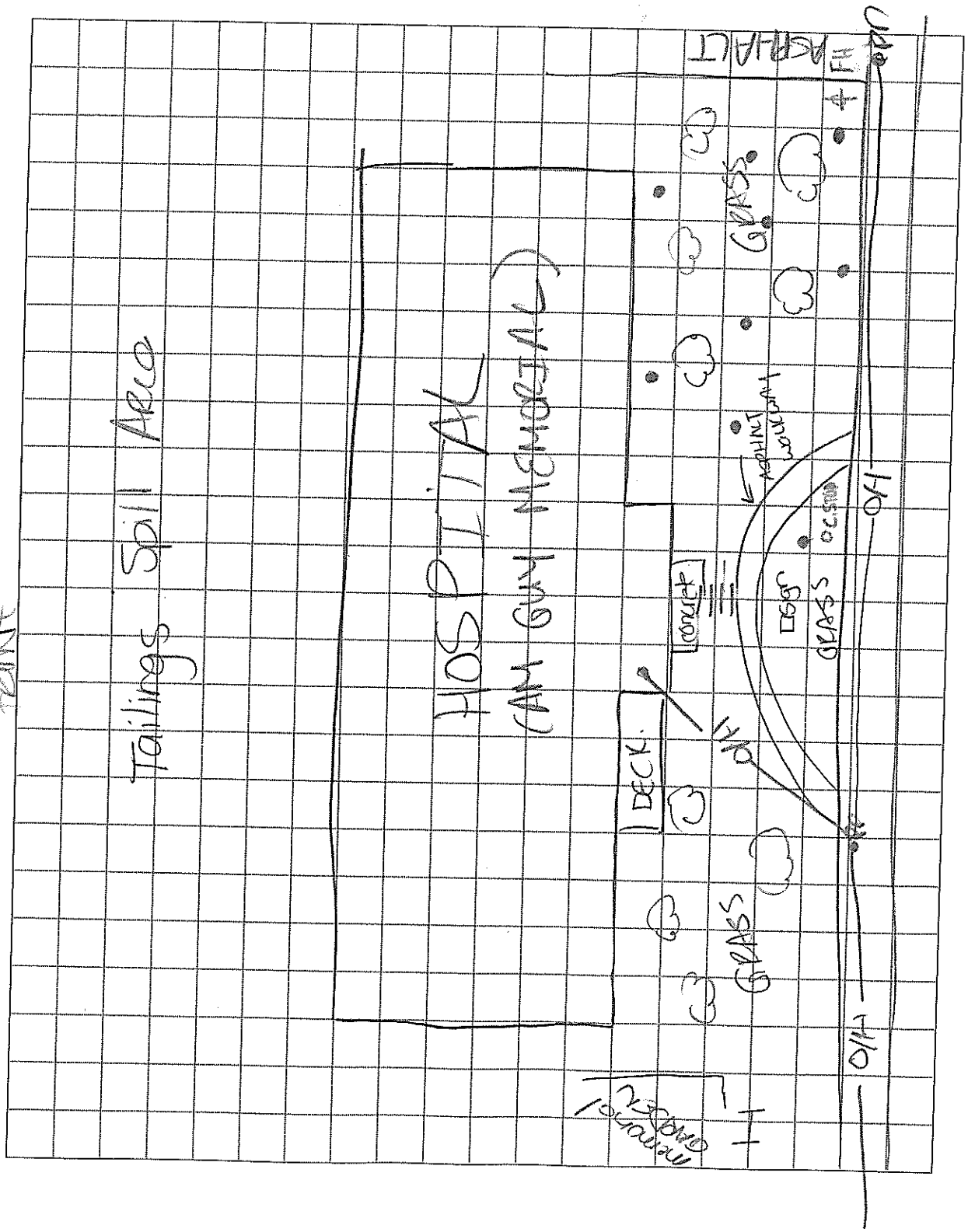
24-553

Buchcans Residential & Public Areas Soil Study
Project Number: 070854

Form 3

SITE PLAN (Show scale or rough measurements)

(Show north arrow, name of street frontage, house/building, outbuildings, road, driveway, garden(s), play structures, decks, electric utility poles, sidewalks, wells, sewers, ditches, storm drains, oil tanks, fill locations, topsoil locations, sub-sample locations, nearby landforms and structures, and direction and number of each photo)



Buchcans Residential & Public Areas Soil Study
Project Number: 070854

Form 4

FIELD DATA (Complete one form per sample location)

Date: June 26/2010 Time in: 10:05 Time out: 10:35 Team: CS / SF / PB

Temperature: 18°C Weather Conditions: Sunny, Clear

Owner notified of team arrival/departure: ☐ Yes ☑ No (left card) If no, why? Public Area Sample ID: Z4-553

Observations	Sample Intervals 0-5cm
Any vegetation present?	Yes - Grass + Trees
Vegetation/grass cover removed for sampling?	Yes
Staining/odours present?	No
Visual appearance and texture of soil	Silty sand w/ topsoil, moist
Approximate depth range of all sub-sample collected	0-10cm

Description of any problems encountered during sampling: No

Description of any features that could influence soil chemistry (1): Nearby tailings spill area

☑ Photos taken of sample location and any features of the location that could influence soil chemistry. Indicate all photo locations and directions on site plan (Form 3).

(1) i.e. compaction (heavy vehicles), backyard construction area, auto servicing area, metal clothes hanging structures, heavily fertilized/manicured lawn, unusual vegetation appearance, etc.

APPENDIX B

LABORATORY CERTIFICATES OF ANALYSIS

Your Project #: 070854
Site: RISK MGMT BURCHANS.,NL
Your C.O.C. #: 13094

Attention: Brian Luffman
Conestoga-Rovers and Associates Ltd
Mount Pearl/St. John's
PO Box 8353 Stn A
1118 Topsail Rd
St. John's, NL
A1B 3N7

Report Date: 2010/07/09

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B086773
Received: 2010/07/03, 09:24

Sample Matrix: Soil
Samples Received: 10

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Metals Solid Avail. Unified MS - Nper	7	2010/07/05	2010/07/06	ATL SOP 00024 R5	Based on EPA6020A
Metals Solid Avail. Unified MS - Nper	3	2010/07/05	2010/07/07	ATL SOP 00024 R5	Based on EPA6020A

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

MICHELLE HILL, Project Manager
Email: Michelle.Hill@maxxamanalytics.com
Phone# (902) 420-0203

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Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 1

This document is in electronic format, hard copy is available on request.

Maxxam Job #: B086773
Report Date: 2010/07/09

Conestoga-Rovers and Associates Ltd
Client Project #: 070854
Project name: RISK MGMT BURCHANS.,NL

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		GJ5766	GJ5767		GJ5768	GJ5769	GJ5770		
Sampling Date		2010/06/26	2010/06/26		2010/06/26	2010/06/26	2010/06/26		
	Units	**Z4-SS1**	**Z4-SS2**	**RDL**	**Z4-SS3**	**Z4-SS4**	**Z4-SS5**	**RDL**	**QC Batch**
Metals									
Available Lead (Pb)	mg/kg	3600	2700	5	290	530	160	0.5	2198942

Maxxam ID		GJ5771	GJ5772	GJ5773		GJ5774		GJ5775		
Sampling Date		2010/06/28	2010/06/28	2010/06/28		2010/06/26		2010/06/26		
	Units	**Z4-SS6**	**Z4-SS7**	**Z4-SS8**	**RDL**	**Z4-SS-01-D**	**RDL**	**Z4-SS5-DUP**	**RDL**	**QC Batch**
Metals										
Available Lead (Pb)	mg/kg	1400	1000	1400	0.5	4500	5	120	0.5	2198942

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam Analytics International Corporation o/a Maxxam Analytics 200 Bluewater Rd, Suite 105, Bedford, Nova Scotia Canada B4B 1G9 Tel:902-420-0203 Toll-free:800-565-7227 Fax:902-420-8612 www.maxxamanalytics.com

Maxxam Job #: B086773
Report Date: 2010/07/09

Conestoga-Rovers and Associates Ltd
Client Project #: 070854
Project name: RISK MGMT BURCHANS.,NL

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2198942	Available Lead (Pb)	2010/07/06	NC	75 - 125	97	75 - 125	<0.5	mg/kg	1.4	35	105	75 - 125

N/A = Not Applicable
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
QC Standard: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.

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Validation Signature Page

Maxxam Job #: B086773

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

JERRY ARENOVICH, Inorganics Manager

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