NATIONAL OVERVIEW OF ABANDONED COAL GASIFICATION WORKS IN CANADA

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CONTRACT # KE145-6-0728

PREPARED FOR: CONSERVATION AND PROTECTION SERVICE,
ENVIRONMENT CANADA

DATE: JANUARY 31, 1987

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Executive Summary

Coal gasification plants in Canada from the early 1800's to after the Second World War, generated various amounts of coal tar, wastewater, ash and slag. Coal tar, the item of main concern among coal gasification by-products, is composed of polynuclear aromatic hydrocarbons (PAH), light aromatics, phenolics, nitrogen and sulphur compounds, and trace metals.

PAH are ubiquitous in the environment, however certain species, which typically occur in coal tar, are known to be carcinogens. Phenolics, and light aromatics, the other major coal tar constituents, are acutely toxic, and even limited exposure can cause skin burns, eye damage, or vascular problems. Also, the light aromatic, benzene, is known to increase the risk of developing leukemia. Coal tar, when introduced to the environment, can cause soil and groundwater pollution, change groundwater flow patterns and negatively affect plant growth and animal life. As a result of these effects, coal tar is considered to be of great concern to the human population, and the environment.

Coal tar contaminated sites, can be rehabilitated in various ways, depending on the extent and form of contamination, which must be determined in an assessment evaluation program. Surface water and groundwater control, and leachate collection and treatment are suitable methods of remediation for contaminated water, however, these methods do not remove the actual waste material from the soil. Direct action, such as removal for subsequent treatment/disposal, or in-site biodegradation, maybe required to completely rehabilitate the site.

Case studies of three sites which have undergone some degree of remediation, confirm that total removal and treatment is the most accepted approach in dealing with coal tar contaminated areas.

Almost 150 coal gasification sites have been identified in this report, through archival research and personal contact with private companies and government agencies. Of these, over 80 have been verified as being definite coal gas producers. Thirty of the plants listed handled or refined coal tar, and the balance are described in this study as possible coal gas producers.

Montreal, Toronto, and Vancouver have been determined to contain the greatest number of sites per city across Canada. However, if production capacity is used as the determining factor in ranking cities, Vancouver becomes less important, and Sault Ste. Marie becomes more important. Montreal and Toronto remain as the cities ranked first and second under this criteria.

Abandoned coal gasification plant sites exist in 9 of the 10 provinces in Canada. They are found in most major centres, and many smaller ones, especially those which have or had a major industrial presence.

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1.0 Historical Overview of the Coal Gasification Industry in Canada

As early as the 1820's, much of the gas used for lighting, heating and some industrial processes was produced in coal gasification plants. Most of the larger cities, and some smaller towns across Canada had such plants until the introduction of natural gas and pipeline transmission drastically reduced their commercial viability. By the 1950's, most gasification plants were abandoned, demolished, or converted into other industries.

Coal gasification plants ranged in size from less than half an acre (.2 hectares) to over 100 acres (43 hectares) (Environmental Research and Technology, 1984). The main part of the site was the reactor building, where the coal was carbonized, carburetted, and otherwise converted to gas. Although it constituted the most important element of a gasification plant, the reactor building did not compose the greatest area of the site. Spread out in various locations were coal and coke stockpiles or sheds, new and spent oxide containers, gas containers (large metal cylindrical containers), tar wells, sludge ponds, and gas liquor reservoirs.

In larger plants, it was quite common to have distillation buildings and by-product recovery facilities on the site (Environmental Research and Technology, 1984). While these sites may be the source of additional problems, they would also indicate a lower likelihood of coal tar wastes remaining in storage containers on the site.

Many processes and types of plant set-ups were used to produce varied qualities of manufactured gas. The most common products are referred to as coke oven gas, retort gas, carburetted water gas, and producer gas.

Coke oven gas was produced by the carbonization of coal, which released a gaseous material. This was treated to remove such impurities as tar, light oils, ammonia, and sulphur compounds. The result was a high heating-value gas (530 BTU or 559 kjoules) composed mainly of hydrogen and methane (Environmental Research and Technology, 1984).

The retort gas product is similar to coke oven gas, except that during the heating stage, the coal is held in refractory lined containers, or retorts. These retorts either moved continuously through a carbonizing oven, thus always replenishing the supply, or they would discharge the coke and be reloaded throughout the production cycle. Various forms of retorts were used, with the continuous vertical type being the most prevelant.

In carburetted water gas, the heating value of a blue gas, which is produced by passing steam over heated coke, is increased by adding gas from a thermally cracked, or pyrolyzed oil. Heating values of this gas ranged from 500 to 1,000 BTU (525-1050 kjoules), depending on the ratio of components added (Environmental Research and Technology, 1984).

Producer gas was a very low BTU gas manufactured mainly as a fuel to be used in coke ovens and similar operations. This gas was produced by reacting coal or coke with steam and air (Environmental Research and Technology, 1984).

Waste and by-product materials from these processes were sometimes refined for other uses, but in all cases, at least some waste remained which required disposal. During the period of coal gas production, little concern was given to pollution and potential health effects resulting from these processes. For example, wastes were often stored on-site in underground containers, or surface sludge ponds. Discontinuation of a plant often meant demolition of buildings, which temporarily hid the stored wastes, or caused them to be spread out over a larger area. Little in the way of remedial measures were undertaken at these sites, so that at present, there are numerous possibilities for public health and environmental hazards to arise.

2.0 Archival Research Methodology

The Canadian Trade Index (C.T.I.) was selected as a first source to identify abandoned coal gasification sites. It classifies information into coal, coke or gas with subsets of each (Table 1).

Table 1

C.T.I. Classes of Information Compiled to Identify Potential Sites

(i) Coal
(ii) Coal Tar Products
(iii) Coal Handling and Clearing Equipment
(iv) Coke
(v) Gas, Acetylene, Generating and Compressing
(vi) Gas, Carbonic Acid
(vii) Gas, Carburetted Water
(viii) Gas, Illuminating
(ix) Gas, Coal Compressed
(x) Gas, Coal and Water

All of the classes listed in Table 1 except the first proved useful for this study. Class (i) simply identifies coal fields in Eastern or Western Canada. Using the remaining nine classes, lists were compiled for each of eleven cross-sectional surveys of coal gas operations in Canada, established at five year intervals between 1910 and 1960. These materials were cross-tabulated against a list of sites drawn from selected files of RG 81 described below.

RG 81 is the designation given for the records of the Dominion Coal Board and of its predecessor, the Dominion Fuel Board which are held within the Public Archives of Canada. For the present purposes of an overview evaluation, 17 files (Table 2) were drawn from each of eleven of the 211 volumes.

While the examination of RG 81 was not exhaustive, the data drawn from this source proved invaluable to the final identification of coal gasification sites. Table 3 identifies Canadian coal gas companies in 1926 and indicates the importance of each in terms of the number of consumers

and/or the volume of coal used. Data drawn from files for the years 1926, 1929, 1931, and 1935 were used to edit the master files created from examination of the Canadian Trade Index. In this way it was possible to add individual locations identified only in RG 81 and to delete data gathered from the Canadian Trade Index which were identified as natural gas operations.

Perhaps more significantly, it was possible to divide the data into two distinct sets, a "probable" coal based operation, and a "possible" coal based set. The "probable" group includes those companies identified in both the C.T.I. and RG 81; "possible" locations include those identifable in only one source.

Finally, analysis of individual city directories, specifically those for Toronto, Vancouver and Montreal, produced additional sites, confirmed others, and provided addresses through which land use data could be obtained. Additional data were obtained through provincial environment ministries which responded to a questionnaire (Appendix A) regarding the identification and assessment of coal tar contaminated sites presently under investigation.

3.0 Coal Gasification Plant Identification

An overview level of analysis of available archival data resulted in the identification of almost 150 probable or possible coal gas producers, and coal tar refiners. Each of the identified companies was a major user or supplier of manufactured gas during the era of coal gasification dominance in Canada.

Confirmation through RG81 records was obtained for 65 of the sites. Further analysis of the city trade directories for Toronto, Montreal and Vancouver, and comparison with a similar study for Ontario by Intera Technologies, verified an additional 16 locations, for a total of 81 coal gasification plant and coal tar operations. In order to verify the existence of each of the remaining 67 (or more) coal gasification plants in Canada, more intensive archival analysis and confirmation processes are required.

Table 2

List of Files In RG 81 Selected for Inspection

Vol.	File #	File Summary	Date
61	53-2-8	Coal licensing scheme	
73	54-3-1	Analysis of Coke	1972-48
73	54-4-1	Analysis of Briquettes	1948-53
93	63-11-5	Gas Plants	1926-1931
93	63-11-6-1	Gas Statistics	1926-36
93	63-11-6-2	Gas Statistics	1929-1961
93	63-11-15	Natural gas in Western Canada and effects on the Coal industry.	1946-1958
94	63-11-16Pt.1	Use of gas in lieu of Coal in public buildings.	1955-60
96	63-12-17	Synthetic Liquid fuels	1945-46
97	63-14-1	Pulverized Coal	1924-60
97	63-14-4	Pulverized Coal Tests	
101	64-1-2	General Fuel Statistics	1923-55
101	64-1-2	General Fuel Statistics	1931-42
102	64-1-2-1	General Fuel Statistics	1932-38
108	66-1-5	Coke Distribution	1938-1958
179	64-4-28	Coal Consumption and requirements	1948-1965
209	#100	Coke and gas making properties in part of British Columbia.	June, 1946

Coal Gas Companies in Cana in 1926

U.S. COAL (tons)			NUMBER OF CONSUMERS	CANADIAN COAL (tons)
	Corp. of the City of Nelson,	Nelson	700	644
	New Westminster Gas Co.,	New Westminster	500	1,371
2,978	Vancouver Gas Co. Ltd.,	Vancouver		52,099
	Victoria Gas Co. Ltd.	Victoria	4100	8,581
	MANITOBA			
1,891	Canada Gas & Electric Corp.	Brandon	1125	
42,622	Winnipeg Electric Railway Co.	Winnipeg		
	NEW BRUNSWICK			
1,277	New Brunswick Power Co.	Saint John	1582	3,571
	NOVA SCOTIA			
1,562	Nova Scotia Tramways & Power Company Limited	Halifax	1969	8,301
	ONTARIO			
97	Barrie Gas Co. Ltd.	Barrie	700	
1,548	Belleville Gas Dept.	Belleville	1544	
400	Public Utilities Comm.	Brockville	2041	
787	Hydro-Electric Power Comm.	Cobourg	408	
242	Stormont Electric Light & Power Company Limited	Cornwall	435	
6,192	Board of Light & Heat Comm	Guelph	3900	
	United Gas & Fuel Co. Ltd.	Hamilton	874	
1,507	Public Utilities Comm.	Kingston	3536	
5,391	Kitchener Light Comm.	Kitchener	4192	
22,822	City Gas Co. of London	London	11,990	
	Hydro-Electric Pow. Comm.	Oshawa	1357	
34,318	The Ottawa Gas Co.	Ottawa	18,015	
3,486	Public Utilities Comm.	Owen Sound	1464	
161	Hydro-Electric Power Comm.	Peterborough	3080	
690	Port Hope Gas Co.	Port Hope	359	
7,016	Gas Department,	St. Thomas	3700	
	Great Northern Gas Co.Ltd.	Sault Ste. Marie		
2,099	Stratford Gas Co.	Stratford	1170	
262,448	Consumers Gas Co.	Toronto	137,182	
	Waterloo Water & Light Comm.	Waterloo		
	QUEBEC			
234,728	Montreal Light, Heat & Power Cons.	Montreal	127,083	7085
1,309	Quebec Railway Light, Heat & Power Company Limited	Quebec	8159	
	City Gas & Electric Dept.	Sherbrooke	1770	
	Gas Dept., Corp. of Sorel	Sorel	410	
635,571				81,652

As much as possible, data relating to the type of plant, and years of operation are provided. Land use information, and hydrogeologic data is presented for only a few well-documented sites.

3.1 Analysis of Findings

Table 4 indicates the number of plants in operation in Canada at five year intervals from 1910 to 1960. Where confirming material is available, these data indicate similar numbers of plants as those suggested by other sources, for example, RG 81. For the year 1930, Table 4 lists 36 probable coal and coke gas operations and an additional three sites thought to be coal and coke gas operations. RG 81 suggests there were 41. By contrast, for 1935, RG 81 reports 32 gas and coke gas plants and our data suggest that there were 35. The numbers are sufficiently close to provide a sense of comfort that the sites identified in Table 4 are accurate in terms of being coal gasification, or coal tar plants.

Table 4

Coal Gas and Related Plants, 1910-1960

Year	Number of Sites	Probable Coal or Coke Gas Plant	Possible Coal or Coke Gas Plant	Coal-tar Plant
1910	5	-	1	4
1915	9	-	2	7
1920	35	18	11	5
1925	50	34	8	4
1930	46	36	3	3
1935	42	30	5	3
1940	22	14	2	3
1945	23	14	3	3
1950	26	12	6	5
1955	22	8	5	7
1960	20	6	4	8

Apparently, the peak period of coal gas operations was around 1925 when a total of 50 plants were in operation. By the outbreak of World War II, this number had declined dramatically.

A compilation of the data found through archival research, personal communications with private companies, and provincial environment ministries, is presented in Table 5. This table indicates the number and distribution of coal gasification and related plants in Canada, their years of operation (based on 5 year intervals), the type of plant, and the type of gas produced at each site.[1] As well, Table 5 names those plants which have been determined, through cross-checking with various sources, definitely to be coal gas producers, which were possible coal gas producers, and which were involved in refining or handling of coal tar in some way.

Generally, the companies listed in Table 5 were industrial plants, or public utilities operations. The largest operations were steel companies, specifically the British Empire Steel Corporation of Montreal, Algoma Steel in Sault Ste. Marie, and the Steel Company of Canada in Hamilton. In 1931 these companies and others like them accounted for the production of 2,255,600 tons of coke and waste material from by-product coking ovens. There were 714 such ovens in Canada that year. British Empire Steel at Sydney Mines owned 300 active ovens, and 190 idle ovens, and produced 28.8% of the total. Algoma Steel maintained 160 ovens at Sault Ste. Marie and produced 25.5% of total output, and the Steel Company of Canada with 80 ovens produced 375,000 tons (Public Archives Canada, RG 81, 1930).

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[1] Gas Type Indicated on Table 5.
A - Illuminating Gas
B - Coal and Water Gas
C - Carburetted Water
D - Cooking and Heating Gas
E - Coal Compressed Generating

The Coal Gas and Byproduct Sites 1910-1960 map (see accompanying map) shows the distribution of known and possible sites of coal gas and coke gas operations in Canada as well as the location of coal tar sites which also pose potential contamination problems. The conclusion is that the problem is truly a national one; every province except Prince Edward Island contains at least one site. However, the potential harmful effects of residue from this period is particularly marked in the traditional industrial heartlands of the country, that is in Quebec and Ontario. This is also the area where Canada's population is most dense. The problem is of course an urban one with a very strong correlation with population size. As the Coal Gas and Byproduct Sites 1910-1960 map (see accompanying map) and Table 5 show, Montreal contains the greatest number of potential sites (28 sites), followed by Toronto (14 sites), Vancouver (12 sites) and Hamilton (7 sites). Interestingly, Sault Ste. Marie has a number of sites equal to that of the demographically larger Winnipeg.

If quantity of material produced is used as the ranking criteria rather than total number of sites, then the picture is a little different. Based upon production figures from RG 81, the Gas and Coke Production 1935 map (see accompanying map) displays both the volume and type of gas production across Canada in descending order of magnitude for the year 1935. By this criterion Sault Ste. Marie moves up a rank to third and Hamilton remains fourth. Vancouver, which ranked third in terms of the number of sites, moves down to fifth position in terms of production out-put. Regardless of which criteria is employed Montreal and Toronto rank first and second respectively.

3.2 Land Use Data

Table 6 indicates land use or zoning information for a number of the sites identified in this study. The sources of this data include 1968 land use plan compilation maps for Toronto and Vancouver, and personal communication with planners from the other cities, regarding present zoning and land use designations. With regard to this information,

Table 5a - Coal Gasification and Coal Tar Sites: Probable Coal Tar Producers

	PROV	CITY	COMPANY	GAS TYPE	BEG	END
1.	BC	ANYOX	Granby Consolidated Mining, Smelting & Power Co.			1930
2.	BC	FERNIE	Crow's Nest Pass Coal Co., Ltd.			1960
3.	BC	NELSON	City of Nelson Gas Co., Ltd; 1940 Corporation of the City of Nelson	A,D	1920	1955
4.	BC	NEW WESTMINISTER	New Westminister Gas Works; 1925 Gas Co., Ltd.	A	1920	1930
5.	BC	VANCOUVER	British Colombia Electric Railway Co.; 1930, B.C. Electric and Gas; 1935, False Creel	A,D	1925	1955
6.	BC	VANCOUVER	Canada Foundry Ltd.			
7.	BC	VANCOUVER	Granbvy Consolidated Mining, Smelting and Power Co.; 1935 Anyox, B.C.	A	1920	1935
8.	BC	VANCOUVER	John McDougall Caledonian Iron Works			
9.	BC	VANCOUVER	Pintsch Compressing			
10.	BC	VANCOUVER	Vancouver Gas Co., Ltd.	A	1920	1930
11.	BC	VICTORIA	B.C. Electric			
12.	BC	VICTORIA	Victoria Gas Company	D	1930	1960
13.	ALTA	COLEMAN	International Coal and Coke			
14.	SASK	MOOSE JAW	Pintsch Compressing			
15.	MAN	BRANDON	Canada Gas and Electric Corp.	A	1925	1930
16.	MAN	BRANDON	Manitoba Power Commission		1935	
17.	MAN	MORRIS	Shawinigan Chemicals		1930	
18.	MAN	WINNIPEG	Pintsch Compressing			

Table 5a - Coal Gasification and Coal Tar Sites: Probable Coal Tar Producers

	PROV	CITY	COMPANY	GAS TYPE	BEG	END
19.	MAN	WINNIPEG	Winnipeg Electric Railway Co.	D	1925	1960
20.	ONT	BARRIE	Barrie Gas Co., Ltd.; 1930, Barrie Light, Water and Gas Commission	A	1925	1935
21.	ONT	BELLEVILLE	Belleville Gas and Fuel Co., Ltd.	A	1925	1930
22.	ONT	BELLEVILLE	Ontario Shore Gas Co.		1935	
23.	ONT	BRANTFORD*				1913
24.	ONT	BROCKVILLE	Brockville Public Utilities Commission		1925	1935
25.	ONT	CAMBRIDGE (GALT)*				1910
26.	ONT	COBOURG	Cobourg Hydro-Electric		1925	1935
27.	ONT	CORNWALL*				1920
28.	ONT	DESERONTO*				1920
29.	ONT	DUNDAS*				1920
30.	ONT	GUELPH	Board of Light and Heat Guelph		1925	1935
31.	ONT	HAMILTON	Hamilton By-Product Coke Ovens, Ltd.	A,D	1925	1935
32.	ONT	HAMILTON	Steel Company of Canada			
33.	ONT	KINGSTON	Public Utilities Commission Kingston		1925	1935
34.	ONT	KITCHENER	Kitchener Light Commissioners; 1930 PUC Kitchener	A,B,C,D,	1920	1955
35.	ONT	LINDSAY*				1900
36.	ONT	LISTOWEL*				1915

Table 5e - Coal Gasification and Coal Tar Sites: Probable Coal Tar Producers

	PROV.	CITY	COMPANY	GAS TYPE	BEG	END
37.	ONT	LONDON	City of London Gas	A,C,	1920	1935
38.	ONT	NIAGARA FALLS*				1920
39.	ONT	OSHAWA	Hydro-Electric Power Co.		1925	1930
40.	ONT	OSHAWA	Ontario Shore Gas Co., Ltd.		1935	
41.	ONT	OSHAWA	Public Utilities Commission		1930	
42.	ONT	OTTAWA	Ottawa Gas Co., The	A,D	1920	1960
43.	ONT	OTTAWA	Ottawa Light, Heat and Power Co., Ltd., The	A,D	1930	1950
44.	ONT	OWEN SOUND	Public Utilities Commission of Owen Sound	A,D	1920	1945
45.	ONT	PETERBOROUGH	Peterborough Gas Works; 1930 Hydro-Eelectric Power	A	1920	1930
46.	ONT	PETERBOROUGH	Public Utilities Commission		1930	1935
47.	ONT	PORT HOPE	Port Hope Gas Light Co., Ltd.	A,D	1920	1940
48.	ONT	SAULT STE. MARIE	Algoma Steel		1935	
49.	ONT	SAULT STE. MARIE	Great Northern Gas		1925	1930
50.	ONT	SIMCOE*				1901
51.	ONT	ST. CATHERINES*				1920
52.	ONT	ST. THOMAS	St. Thomas Gas Dept.; 1935, P.U.C.		1925	1935
53.	ONT	STORMONT	Stormont Electric Light and Power Co.		1925	
54.	ONT	STRATFORD	Stratford Gas Co., Ltd.; 1930 P.U.C.	A,B,C,D	1920	1950

Table 5a - Coal Gasification and Coal Tar Sites: Probable Coal Tar Producers

	PROV	CITY	COMPANY	GAS TYPE	BEG	END
55.	ONT	SUDBURY*				?
56.	ONT	TORONTO	Consumers Gas Company	A,D	1920	1960
57.	ONT	TORONTO	Petrol-Paulo			
58.	ONT	TORONTO	Pintsch Compressing Co.	A	1925	1935
59.	ONT	TORONTO	San Paulo Gas			
60.	ONT	WALKERVILLE*				1924
61.	ONT	WATERLOO	Waterloo Water and Light Commission	A	1920	1925
62.	ONT	BRAMPTON*				1915
63.	ONT	FORT STANLEY*				1953
64.	ONT	SARNIA*				1925
65.	QUE	SOREL	Gas Dept. Sorel		1925	
66.	QUE	MONTREAL	British Empire Steel Corporation, Ltd.			1930
67.	QUE	MONTREAL	Dominion Steel			
68.	QUE	MONTREAL	Dominion Steel & Coal Corp., Ltd.			1960
69.	QUE	MONTREAL	Montreal Coke and Manufacturing			
70.	QUE	MONTREAL	Montreal Light, Heat & Power Co.	A,D	1920	1945
71.	QUE	MONTREAL	Pintsch Compressing			
72.	QUE	MONTREAL	Steel Company Canada			

Table 5e - Coal Gasification and Coal Tar Sites: Probable Coal Tar Producers

	PROV	CITY	COMPANY	GAS TYPE	BEG	END
73.	QUE	QUEBEC	Que. Railway, Light & Power Co., Ltd.; 1925, Que. Power Co.; 1935, St. Malo; 1940 Quebec, Que.	A,C,D	1920	1960
74.	QUE	SHERBROOKE	Corporation of Sherbrooke	C	1920	1945
75.	QUE	VILLE LASALLE	Montreal Coke & Mfg.Co.			
76.	NB	MCADAM	Pintsch Compressing			
77.	NB	SAINT JOHN	New Brunswick Power	D	1925	1950
78.	NS	HALIFAX	Nova Scotia Tramways & Power Co.; 1930 Hydro-Electric Power	A,D	1920	1950
79	NS	SHERBROOKE	City of Sherbrooke Gas Department	A	1920	1930?
80	NS	SYDNEY	Dominion Coal Co., Ltd.			
81.	NFLD	ST. JOHN'S	St. John's Gas Light Co.		1930	

Table 5b- Coal Gasification and Coal Tar Sites: Possible Coal Tar Producers

	PROV	CITY	COMPANY	GAS TYPE	BEG	END
1.	BC	VANCOUVER	Balfour, Guthrie & Co.			
2.	BC	VANCOUVER	Evans, Coleman & Evans			
3.	BC	VANCOUVER	H.H. Abott and Company			
4.	BC	VANCOUVER	MacDonald-Marpole			
5.	ALTA	CALGARY	Hudson's Bay Oil & Gas Co. Ltd.	A	1935	
6.	ALTA	CALGARY	Progras Ltd.	D	1960	
7.	ALTA	CALGARY	Royalite Oil., Ltd.	A,D	1935	1940
8.	ALTA	EDMONTON	Northwestern Utilities Ltd.	D	1950	1960
9.	MAN	BRANDON	Brandon Gas & Power Co., Ltd.	E,A	1920	1925
10.	ONT	CHATHAM	Chatham Gas Co., Ltd.	A	1915	1925
11.	ONT	HAMILTON	United Gas & Fuel Co. of Hamilton	A,C,D	1920	1960
12.	ONT	INGERSOLL	Ingersoll Gas Light Co.,Ltd.	A	1920	1935
13.	ONT	NAPANEE	Napanee Gas Co.	A	1920	
14.	ONT	OSHAWA	City Gas of Oshawa			
15.	ONT	OTTAWA	Interprovincial Utilities Ltd.	D	1955	
16.	ONT	PETROLIA	Petrolia Utilities Co.,Ltd.,The	A	1925	
17.	ONT	TORONTO	City Gas Co. of Oshawa	C,A	1920	1925
18.	ONT	TORONTO	Dominion Oxygen (Operating Prestolite)			
19.	ONT	TORONTO	Hydro-Electric Power Commission of Ont.	A	1930	
20.	ONT	TORONTO	Prest-O-Lite Co. of Canada Ltd.	A	1930	
21.	ONT	WINDSOR	Canadian Gas Co., Ltd.	A	1920	

Table 5b - Coal Gasification and Coal Tar Sites: Possible Coal Tar Producers

	PROV	CITY	COMPANY	GAS TYPE	BEG	END
22.	ONT	WOODSTOCK	Woodstock Gas Light Co., Ltd.	A	1925	
23.	QUE	MONTREAL	Blaugas Co. of Can. Ltd.; 1920, Canadian Blaugas Co.	A,E	1910	1920
24.	QUE	MONTREAL	Canadian Carbonate			
25.	QUE	MONTREAL	Comp. Manufacturiere de Lachine			
26.	QUE	MONTREAL	L'Air Liquide Society	E	1920	
27.	QUE	MONTREAL	LaSalle Coke			
28.	QUE	MONTREAL	Laurie and Lamb			
29.	QUE	MONTREAL	Montreal Coke & Mfg. Co.	D	1935	1950
30.	QUE	MONTREAL	Paterson Manufacturing Co.			
31.	QUE	MONTREAL	Quebec Hydro-Electric Commission	D	1950	1955
32.	QUE	MONTREAL	Solex Company Limited			
33.	NB	MONCTON	New Brunswick Gas & Oilfields, Ltd.	D	1945	1960
35	NS	LUNENBURG	Lunenburg Gas Co., Ltd.	A	1920	1925
36	NS	SYDNEY	Dominion Coal Company			
37	NS	SYDNEY	Saunderson Manufacturing Company			
38	NS	HALIFAX	Halifax Gas Works	B		1850
39	NS	HALIFAX	People's Heat & Light Co.	B		1850
40	NS	HALIFAX	N.S. Light & Power	B		1920
41	NS	PICTOU	Pictou Gas & Light Co.			
42	NS	LUNENBURG	Lunenburg Gas Co.			1880

Table 5c - Coal Gasification and Coal Tar Sites: Coal Tar Refiners

	PROV	CITY	COMPANY	GAS TYPE	BEG	END
1.	BC	VANCOUVER	Barrett Company Limited			
2.	BC	VANCOUVER	Paterson Manufacturing			
3.	BC	SIDNEY	Sydney Rubber Roofing Co., Limited		1920	
4.	MAN	WINNIPEG	Barrett Company			
5.	ONT	HAMILTON	Currie Products, Ltd.		1935	1960
6.	ONT	HAMILTON	Dominion Tar & Ammonia Co., Ltd.		1915	
7.	ONT	HAMILTON	Hamilton Tar Distilling Co.		1915	1930
8.	ONT	HAMILTON	Steel Company of Canada Ltd.; Montreal, Que.		1950	1960
9.	ONT	PORT ARTHUR	Northern Wood Preservers Ltd.		1955	1960
10.	ONT	SAULT STE. MARIE	Dominion Tar & Chemical			
11.	ONT	TORONTO	Barrett Company; 1925, MTL., WINN., VAN.; 1940, Montreal only		1920	1960
12.	ONT	TORONTO	Currie Products			
13.	ONT	TORONTO	Dominion Tar and Chemical			
14.	ONT	TORONTO	Hamilton Coal Tar Products			
15.	ONT	TORONTO	Koppers Products Ltd.		1955	1960
16.	ONT	TORONTO	Paterson Mfg. Co., Ltd.			
17.	ONT	OTTAWA	Currie Products Lees Ave.			
18.	QUE	MONTREAL	Barrett Company			
19.	QUE	MONTREAL	Building Products Ltd.; 1960 LaSalle, Que.		1950	1960
20.	QUE	MONTREAL	Dominion Tar & Chemical			

Table 5c - Coal Gasification and Coal Tar Sites: Coal Tar Refiners

	PROV	CITY	COMPANY	GAS TYPE	BEG	END
21.	QUE	MONTREAL	G. Reed			
22.	QUE	MONTREAL	Holliday, Land B.			
23.	QUE	MONTREAL	McArthur Alex., & Co. Ltd.		1915	1925
24.	QUE	MONTREAL	McComb, J.H. Ltd.		1915	1920
25.	QUE	MONTREAL	National Coal Tar Co.		1910	
26.	QUE	MONTREAL	Paterson Mfg. Co., Ltd.		1915	
27.	QUE	MONTREAL	Record Chemical Co., Inc.		1960	
28.	QUE	MONTREAL	Steel Company Canada			
29.	NB	ST. JOHN	Carritte, deB.,		1910	1960
30.	NS	SYDNEY	Dominion Tar & Chemical Co. Ltd.		1910	1960
31.	NS	SYDNEY	Saunderson Mfg. Co., Ltd.		1910	

especially from the 1968 sources, it should be understood that actual use of the sites in question may vary from that listed. Land use information from Table 6 indicates that of the sites listed, 86% are in residential and/or commercial areas. 73% of the abandoned coal-gasification plant sites are now in strictly residential areas.

Also indicated on Table 6 is the proximity of sites to major surface water bodies. It is noted that most sites are served by, or are near water mains and sewer lines. Proximity to groundwater aquifers, however, must be determined individually as part of a site investigation program.

4.0 Nature of Coal Gasification Plant Wastes

The characterization of coal gas plant wastes is complicated by the fact that a variety of production methods and many ranks or compositions of coal were used between the early 1800's, and the mid 1900's (Mahlum et al., 1981). The main types of gas plants were coke oven, carburetted water gas, producer gas, and retort gas operations (Environmental Research and Technology, 1984). These produced a variety of wastes and by-products including, coal tar, sludge and pitch, ash and slag, sulphur and nitrogen compounds, wastewater, trace metals, and numerous organic compounds.

Coke oven gas plants produced substantial by-product coal tar, however, most of this tar was recycled on-site or sold to coal by-product manufacturers and distillers such as Stelco in Hamilton, Ontario (Intera Technologies, 1986). The distilled tar was used to produce some industrial fuels, road and roofing tars, wood preservatives, and sealants (Braunstein et al, 1981). As such, most coke oven gas plant sites may have little, if any, remaining coal tar wastes

Carburetted water, producer, and retort gas plants tended to retain most of the coal tar on site, either in storage tanks, or sludge ponds. Water gas plants generally produced more tar in the coal gasification process, than did producer gas or retort gas plants (Environmental Research and Technology, 1984). Some water gas plants did recycle the coal tar wastes, thus lessening the likelihood of large coal tar reserves on abandoned plant sites. However, producer and retort plants, which produced approximately 10 gallons of dry coal tar per ton of dry

Table 4

Land Use Information for Identified Coal Gasification Sites

Plant Location	Zoning or Land Use	*Proximity to Water Sources
Québec		
LaSalle Coke, Ville de LaSalle, Québec	Commercial, with Residential 400m to east	
Québec Power Verdun St., Québec City	Residential	1km south of St. Charles River
Lockerby and McComb 65 Shannon St., Montréal	Industrial	
McArthur, Alex & Co. 82 McGill St., Montréal	Commercial & Residential	
Paterson Mfg. Carrier & St. Hubert, Montréal	Commercial & Industrial	
Reed, Geo. W., & Co. 37 St. Antoine, Montréal	Commercial	
Montréal Coke Mfg. 660 St. Catherine, Montréal	Commercial	
LaSalle Coke 930 Mt. Royal Ave. E Montréal	Commercial & Residential	
LaSalle Coke 6680 St. Hubert Montréal	Commercial & Residential	
Ontario		
Rideau River/Lees Ave. 175 Lees Ave., Ottawa	Residential, Transportation & Parking	adjacent to Rideau River
Public Work Bldg. King Edward & York St. Ottawa	Commercial, 2 blocks from Residential	

*most sites are near sewer lines and water supply mains.

Table 6 (cont'd)

Land Use Information for Identified Coal Gasification Sites

Plant Location	Zoning or Land Use	*Proximity to Water Sources
CN Property William & Regina St. Waterloo	Commercial	near Laurel Creek & 4 water supply wells
Barrett Mfg. Co. Villiers & Saulter St. Toronto	Industrial, Transportation & Storage	near Toronto Harbour
Barret Mfg. Co. 172 King St. E. Toronto	Commercial	
Currie Products/Hamilton Coal Tar 15-19 Birch Ave., Toronto	Commercial, Storage & Parking	
Consumers Gas Co. 415 Eastern Ave., Toronto	Industrial, Transportation & Storage	near Don River
Pintsch Compressing Co. John & Front St., Toronto	Transportation & Parking 1 block from Commercial	
Petrol Oil & Gas Co. 414 Bay, Toronto	Institutional 1 block from Commercial	
Petrol Oil & Gas Co. 146 King St. W., Toronto	Commercial	
San Paulo Gas Co. 25 King St. W., Toronto	Commercial	
San Paulo Gas Co. 357 Bay, Toronto	Commercial	
British Columbia		
Canada Foundry Co. 1065 Pender W., Vancouver	Industrial & Commercial	2 blocks from Burrard Inlet
B.C. Electric Railway Co. 1444 Lansdale, Vancouver	Commercial	

*most sites are near sewer lines and water supply mains.

Table 6 (cont'd)

Land Use Information for Identified Coal Gasification Sites

Plant Location	Zoning or Land Use	*Proximity to Water Sources
B.C. Electric Railway Co. 425 Carrall, Vancouver	Commercial, 1 block from Institutional, .5km from Residential	
B.C. Electric Railway Co. 600 Granville, Vancouver	Commercial	
B.C. Electric Railway Co. 1138 Keefer, Vancouver	Commercial	
Paterson Mfg. Co. /Barret Co. Ltd. 10th Ave. W. & Arbutus, Vancouver	Commercial, 1 block from Residential	
Abbott, H.H., & Co. 448 Seymour, Vancouver	Commercial, 1 block from Institutional	3 blocks from Burrard Inlet
Evans, Coleman & Evans Columbia Ave. Wharf Vancouver	Storage & Transportation	On Burrard Inlet
MacDonald-Marpole Co. 427 Seymour Vancouver	Commercial	3 blocks from Burrard Inlet

*most sites are near sewer lines and water supply mains.

carbonized coal, typically did not recycle the bulk of the waste tar material (Wilson and Wells, 1950).

4.1 Coal Gases and By-Products

The main coal gasification by-products of concern in this study are coal tars, sludges and pitches. Wastewater produced during plant operation would be of concern, however, dilution, degradation, and volatilization processes which have been in operation since the waste water entered the environment (minimum 30 yrs.) would have reduced the effluent to, at worst, a moderately toxic state. Ash, slag, and trace metals in the wastes would be stable enough to not pose a threat of spreading to contaminate soil and ground water.

Coal tar is comprised of numerous organic and inorganic compounds. The main chemical classes are polynuclear aromatic compounds (PAH), phenolics, light aromatics, nitrogen and sulphur compounds, and trace metals (Environmental Research and Technolgy, 1984). Relative to these classes, the main difference between the various coal gasification process is that tars from carburetted water gas production contain no phenolics. A brief description of each of these chemical classes follows.

4.1.1 PAH

Polynuclear aromatic hydrocarbons, also called polycyclic aromatic hydrocarbons, are compounds made up of three or more fused benzene rings. These are geochemically stable (ie. non-volatile), and have low aqueous solubilities (Handbook of Chemistry and Physics, 1986).Adsorption to clay particles is a dominant factor in the persistence of PAH in soils. Microbial degredation, even in highly aerobic environments is slow, and removal of PAH from groundwater is, at present, only 30-80% efficient (Herbes et al., 1980).

PAH are ubiquitous in the environment, as they occur naturally, and as the result of almost any combustion or burning process (car combustion, cigarette smoke, forest fires, etc.). The EPA criterion for total PAH is

10 ppb, while the limit for carcinogenic species of PAH is 28 ppt. The most important PAH compound, in that it is a known carcinogen, is benzo (a) pyrene (BaP), which has a limit of 10 ppt in drinking water, set by the World Health Organization.

Coal tar is composed primarily of PAH. Whereas PAH is ubiquitous in nature, the problem in coal tar arises in the high concentrations of total PAH, and in the presence of known carcinogens, including benzo (a) pyrene (BaP), benzo (j) fluoranthene (BjF), and Indeno (1,2,3-cd) pyrene (IP) (Noyes Data Corporation, 1980).

4.1.2 Phenolics

Phenolics are hydroxylated one-ring aromatic compounds, of which the main ones in coal tar are phenol, creosols, and xylenols (Environmental Research and Technologies, 1984). They are found naturally in all soils, and occur in most coal tars, except those produced in carburetted water gas plants. These compounds are not very volatile, but have high solubility, and can move freely with the ground water. Adsorption to clay particles is negligible, however phenolics due tend to be attracted to organic matter in the soil. In this way, further tendencies for movement out of coal tar, even in a non-aqueous environment, is possible, though restricted.

Biodegradation of phenolics is the dominant factor which controls their movement through soils and/or into the groundwater. Leaching, due to the downward percolation through the aerated zone of the soil, causes only limited transport of phenolics.

4.1.3 Light Aromatics

Light aromatics, or monoaromatic compounds present in coal tars are mainly in the form of BTX (Benzene, Toluene, Xylene), which are moderately soluble, volatile organics. MOE (Ontario Ministry of Environment) recommended guidelines for light aromatics in drinking water are maximums of 25, 60, and 50 ppb, for benzene, toluene, and xylene respectively.

Light aromatics are present throughout the environment as a result of various man-made sources (Environmental Research and Technology, 1984). They have a very low tendency for adsorption, and may move freely with the groundwater. The main form of attenuation of light aromatics, besides their volatility, is biodegradation, which is very effective in aerobic zones in the soil.

4.1.4 Nitrogen, Sulphur and Trace Metals

Coal tar contains numerous inorganic compounds, including ammonium sulphate, cyanide, nitrate, sulphate, elemental sulphur, arsenic, chromium, lead, and zinc (Braunstein et al., 1981). Typically, these compounds occur in fairly low concentrations, and most, with the exception of sulphates and nitrates, have low solubilities, and tend to be stable in the soil. Certain nitrogen and sulphur species are biodegradable to some degree and most metals adsorb to soils, thus limiting the effect of these compounds.

4.2 Health and Environmental Effects

All main constituents of coal tar behave in the environment in the same way. They adsorb to soil particles, and dissolve to some extent in ground water. Due to capillary and other soil potential forces, the wastes can spread to affect a larger area. Also, volatiles released from the coal tar can be trapped and accummulate to very toxic levels. The presence of coal tar in the soil can causes changes to normal groundwater flow, and it can negatively affect plant growth, and animal life. Table 7 outlines some of the effects on the environment of the main compounds which make up coal tar.

Table 7

Behaviour of Coal Tar Constituents in the Environment

	Acute Toxicity	Chronic Effects	Wastewater Removal Efficiency	Microbial Degradation
Polycyclic Aromatic Hydrocarbons	Low	High	Low	Slow
Phenols	High	Low	High	Rapid
Light Aromatics	Moderate	Low	Moderate	Moderate
Nitrogen Compounds	Moderate	High	Low	Slow
Sulphur Compounds	Moderate	High	Low	Slow

(Adapted from Herbes et al., 1980)

In terms of human health, numerous studies have shown that some of the many PAH compounds are carcinogenic. Specifically, benzo (a) pyrene, benzo (j) fluoranthene, and Indeno (1,2,3-cd) are the most common and relevant PAH compounds found in coal tar (Environmental Research and Technology, 1984). Medical studies have shown that these chemicals cause carcinomas and tumors in mice, and results have been extrapolated to relate to the human population. Also, case studies of employees at coal using plants indicate a statistical increase in cancer ratios in such environments (Braunstein et al, 1981). In these cases, the carcinogenic PAH's in coal and coal tar are inferred to be the cause.

Phenolics and light aromatics which make up a substantial portion of coal tar, also pose a definite health hazard. The phenolic compounds, and the toluenes and xylenes (light aromatics) are not carcinogenic, but can be

acutely poisonous if absorbed by the skin, inhaled, or ingested (Environmental Research and Technology, 1984). Abundant data are available which indicate that exposure to these chemicals can cause skin burns, eye damage, and liver, kidney and vascular problems (NIOSH, 1976). The light aromatic compound, benzene, is specifically noted as causing an increase in the risk of developing leukemia (Cheremisinoff et al., 1980).

The well-documented toxicity of the main constituents of coal tar emphasizes the importance of identifying, assessing and if necessary remediating any existing coal tar contaminated sites.

5.0 Other Coal Tar Producers

Although it is beyond the scope of this overview report, it is important to note that coal tar, which is the main substance of concern from coal gasification plants, is also produced and used in other types of industries.

Any operation which used gas produced from by-product coke or coal, for heating, smelting, or running equipment, also produced coal tar as a waste material. Examples of these are steel industries, city gas producers, mining operations and coking industries. Other such plants which didn't produce gas, but did stockpile coal or coke for various uses, also have the possibility of leaving effluents which are similar in composition to some coal gasification wastes. Some of the same compounds, including PAH's, phenolics, and light aromatics, can become incorporated in the ground water as a result of water percolating through the coal piles, and coal decomposition.

Smaller scale industries, such as coal tar distillers and by-product manufacturers, must also be considered when identifying sites which may be contaminated by coal tars. These companies, which produced ammonium sulphate, road tar, creosote, sealants, and/or wood preservatives, may have left coal tar in surface or underground storage containers upon site abandonment. Also, the storage facilities for the coal tar may have leaked on the site during or after plant operation.

6.0 Remedial Action Alternatives

6.1 General Site Assessment

In order to determine appropriate remedial actions, if any are required, preliminary investigation of a potential coal tar site is necessary. An intensive historical background study, on-site surveys, and reviews of published geological and hydrogeological maps or reports on the area should be undertaken to define the extent of the problem. Data such as plant size, current land use, and proximity to surface water, major aquifers, and residential, recreational, or industrial land, should be noted for environmental and human impact assessment.

In gas plant sites determined through background and general assessment to have a high potential for containing buried coal tar and related wastes, intensive on-site testing and sampling must be initiated. The lateral and vertical extent of contamination can be determined by geophysical studies, soil sampling, drilling programs, and piezometer installation. Assessment of the type and concentration of wastes requires physical and chemical analyses of soil and water samples, as well as of the coal tar itself.

6.2 Remedial Action Selection

Having determined the types and extent of contamination at a coal gasification site, the next step is to determine the most appropriate remedial measure(s). Typical considerations include:

- no action;
- total removal of contaminants with associated treatment/disposal;
- surface sealing, impermeable peripheral and basal barriers;
- leachate collection and treatment;
- on site microbial degradation.

The selection of remedial measures would be site specific, and must be chosen based on location of the wastes and any leachate plume, or the proximity to aquifers, lakes and rivers, type of wastes, and site stratigraphy.

6.2.1 Surface Water Control

A capping method meant to divert surface water from the site, is sometimes used to prevent downward percolation of water which may carry contaminants into the ground water. This type of control doesn't remove the problem, and is suitable only in cases where the contaminant is confined to a small area, is well above the water table, and is not subject to lateral dissipation due to movement of vadose zone water (ie. that water found above the water table).

6.2.2 Groundwater Control

Various methods are used to divert groundwater from a contaminated site, or to restrict its movement. Barriers such as slurry walls or grout curtains are formed either up hydraulic gradient from the waste, or to completely enclose it, thus preventing, or restricting dispersion of the contaminant over a larger area.

Groundwater pumping is often used to lower the water table, restrict plume migration, and/or remove contaminated water for treatment.

Barriers are only temporary control methods, and are subject to construction and maintenance problems. Pumping, however, is a widely used method, and is often very efficient. In the case of coal tar contamination, this is not the case, due to the stability and low mobility and solubility of its constituents. Also, removal of polycyclic aromatic hydrocarbons and aromatic amines from wastewater by standard methods has been shown to be only 30-80% efficient (Herbes, 1980). Removal of groundwater for treatment therefore does not eliminate much of the actual waste material from the soil.

6.2.3 Leachate Collection

Surface drains and ditches and subsurface draining aided by injected impermeable liners, can be used to collect effluent running over and through a contaminated site. This method is not suitable for coal tar contamination, for the same reasons as described in the previous section.

6.2.4 Direct Treatment

Direct treatment methods of remediation include total contaminant removal for on or off-site treatment/disposal and in-situ biodegradation.

Total removal is an extremely effective method, and affords complete site remediation. In many cases, however, this process is impossible due to contaminant location, or plume size, and is often subject to very high costs.

Biodegradation of coal tar is possible in most oxygenated and some reducing environments. A variety of bacterial species are known which can break down different components of the coal tar waste. Problems with this method are mainly the long time factor involved, the requirement of a suitable environment, and the possibility that not all components of the coal tar will be decomposed.

7.0 Case Studies

Of the numerous abandoned gasification plant sites which exist across Canada, only a small number have to date undergone any investigations or assessment. These include:

- Rideau River/Lees Ave. Transit Station, Ottawa;
- King Edward St. Public Works Bldg., Ottawa;
- Front St. Library site, Toronto;
- CN property building site, Waterloo;
- Sidney Tar Ponds, Nova Scotia;
- B.C. Place, Vancouver, British Columbia;
- LaSalle Coke site, LaSalle, Quebec;
- Quebec Power site, Verdun St., Quebec City.

Table 8

Assessment amd Remedial Work at Coal Gasification Plant Sites

Site # Years of Operation	Assessment Data Size of Contaminated Area	Volume of Wastes	Location of Wastes	Land Use	Proximity to Surface or Groundwater	Analytical Data	Type of Contaminants	Remedial Measures
Lees Ave/ Rideau River Ottawa, Ont. 1922-	1 hectare	$800m^3$	-underground tanks -sewer lines -Rideau River	Residential parking & transportation	50m to Rideau River	Benzene-6000ppb BaP-2400ppb	PAH, BaP BTX Coal Tar	-Dredged river to remove contaminated sediment -separated, clarified & filtered liquid phase, then release to sewer system -remove sludge for off-site disposal
CN site William St., Waterloo, Ont. 1889-1904		$2000m^3$ -4,000 litres of water in underground tanks	-2 underground storage tanks -soil	Commercial	-near Laurel Creek -adjacent to 4 main water supply wells	PAH 19,000ppb BaP 1,000ppb	PAH Coal Tar	-80,000 litres of well water filter treated to remove contaminants -15,000 tonnes of lightly contaminated soil removed to landfill site -$2,000m^3$ removed removed and stock-piled on site.
350 King Edward Ave. Ottawa, Ont. 1878-1922	1 hectare		-soil -underground tanks	Commercial -nearby Residential	-storm sewers -water mains	PAH in water samples-.01ppb	PAH Coal Tar	

Table 8 (cont'd)

Assessment and Remedial Work at Coal Gasification Plant Sites

Site # Years of Operation	Assessment Data Size of Contaminated Area	Volume of of Wastes	Location of Wastes	Land Use	Proximity to Surface or Groundwater	Analytical Data	Type of Contaminants	Remedial Measures
LaSalle Coke LaSalle, Que.	1.5 hectares	60,000m^3	-2 nine million litre surface storage tanks -tar 2m below surface	Commercial -Residential 400m East	-water mains & sewers	pH-2.0 for groundwater under site	PAH, trace metals, sulphur Coal tar	wastes removed & replaced in 3 clay & synthetic basins -water collected & filtered
Québec Power Verdun St., Québec City, Québec		-wastes mixed with wood chips formed pile on site 2.5m high on west & 1.5m high on east	Surface	Residential	-south of St. Charles River -ground water flow is toward river	up to 4% PAH	Coal tar, oil, coke, sulphur	

An overview of the assessment and remedial work completed at some of the above-noted sites is described in Table 8 of this report.

8.0 Conclusions and Recommendations

Coal gasification plants which operated in Canada from the early 1800's to the 1950's produced an immense volume of waste materials, mainly coal tar (up to 10 gallons per ton of carbonized coal). For the most part, this coal tar was retained on-site in underground tanks, or sludge ponds. Due to demolition, construction, and decomposition of the containers, the wastes have, in a number of cases, spread to contaminate surrounding soils, surface water bodies, and groundwater aquifers.

Coal tar is composed primarily of polynuclear aromatic hydrocarbons, (PAH), light aromatics, phenolics, trace metals, nitrogen and sulphur compounds. The potential negative effect of many of these compounds has been well documented. The recognized carcinogenic PAH's, (benzo (a) pyrene, benzo (j) fluoranthene, and indeno (1,2,3-cd) pyrene) have been proven by laboratory and statistical analyses to cause various forms of cancer. Benzene has been shown to increase the risk of developing leukemia. Other light aromatics and phenolics are acutely poisonous, and also can cause skin and eye irritations, and liver, kidney and vascular problems.

This overview study has revealed over 80 potentially contaminated coal gasification plant sites. It is likely, however, that upward of 150 similar areas actually exist. The majority of the locations are in Ontario, but there are some in 8 out of the 9 other provinces. Since coal tar is a by-product of any industry which produced coke, as well as the coal gasification industry, it is likely that every province has had exposure to this problem.

Of the probable coal gasification sites identified in this study, less than 10 per cent have undergone any form of investigation or assessment. The high number of other potentially contaminated sites, and the fact that those presently being investigated are considered to be definite hazards, infers the likelihood of many similar problems being uncovered in the near future.

As a result of the data compiled in this report, recommendations for further action on the part of the various federal and provincial jurisdictions are as follows:

1. Initiate intensive and detailed archival research studies to locate all potential coal tar contaminated sites.

These should include Canadian Trade Index reviews as well as personal contact with existing companies which were in the coal gasification business. An attempt must be made, either through reviewing fire insurance plans, company records, or air photos, to accurately locate the plant itself, and waste storage facilities.

2. Identify all industries which produced coke commercially or for their own use, as well as all coal gasification plants and coal tar by-product distillers.

Any plant which carbonized coal, or manufactured gas from coal, produced coal tar as a waste or by-product. Since coal tar by-product manufacturers or distillers stored coal tar on site, there is a likely potential for coal tar contamination at these locations.

3. Determine the land use of these sites at present, as well as any other land uses since the closure of the coal gasification, or related plant.

Knowledge of land uses subsequent to the existence of a gasification plant is necessary to assess any potential effects or changes to the location, or mode of storage of the waste material. (e.g. Subsequent construction may have damaged underground storage containers causing leakage, or, such containers may have been emptied, or removed from the site).

Present land use designations are useful in assessing the potential impact, or ranking of the site in terms of various social and environmental effects.

4. A national standardization of site assessment criteria should be introduced.

Such a standard, including data relating to a sampling protocol, handling methods, and safety considerations, would ensure that all relevant information is obtained at the outset of an assessment program. Also, data would be accurate and detailed enough to assess the situation on a national, as well as a local or regional scale.

5. Initiate a standard rating system for potential sites which have not yet been studied in detail.

Each site could be rated as to assessment and cleanup priority, based on factors such as:

Human Impact
- negative health effects
- poor visual aesthetics
- negative effect on land values
- proximity to residential and public use areas

Environmental Impact
- soil contamination
- surface or groundwater pollution
- affect on aquatic and biotic life
- size of effected area

6. Prepare a list of recommended remedial measures based on the priority ranking of individual sites.

ie. Highest priority - requires immediate total removal and treatment of the contaminated material

Medium priority - total removal and treatment suggested
- longer term treatment method suitable
(eg. microbial degradation, or waste containment and leachate collection and treatment)

Low priority - no action suitable for present
- suggest waste containment and/or groundwater pumping to prevent spread of contamination.

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CARLETON UNIVERSITY
RESOURCES DEVELOPMENT RESEARCH CENTRE
NATIONAL OVERVIEW OF COAL GASIFICATION IN CANADA STUDY

Could you please provide the information requested below .If you are unable to do so, please indicate a source that we may contact.

1. Does your organization possess any historical data regarding the past location, type and size of coal gasification or liquifaction plants , as well as any coal tar distillation or by-product industries such as liquid and gaseous fuels, or polycyclic aromatics? (check one)

Yes No

2. If yes, could you provide this data to us at the address shown at the end of this questionnaire.

3. How were the raw materials, final products and various wastes contained on the sites indicated in question 1? (check as appropriate)

lagoons
open stockpiles
drums
above ground tanks
below ground tanks
other (please specify)

4. What are the relevant topographic features of the site and their relation to water table and bedrock depth?

site	topographic feature	depth to water table	depth to bedrock

5. Are there any known surface water or drainage courses in the immediate area?

yes no (check as appropriate)

6. What is the volumetric and areal extent of the on site waste materials or process wastes for each site?

Site name	Location	cu.ft	acres

6. What are the main chemical constituents of waste materials for sites named above, and what are their concentrations?

Site	Main chemical constitutents	Concentrations

7.What remedial measures have been implemented or are being planned for these sites?

Site	Remedial Measure Planned	Used

8. What is the current land use of the site and surrounding environs?

Site	Land Use	Environs

Choose use from the list below

Open Space
Residential
Industrial
Commercial
Parkland
Institutional
Other

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If you have any questions, please contact the Centre at (613) 564-2814
Thank you for your cooperation.