Hope Bay Mining Ltd.

Incinerator Management Plan

Hope Bay, Nunavut, Canada

FINAL

Prepared for:

Hope Bay Mining Ltd.

Prepared by:

SRK Consulting
Engineers and Scientists

Project Reference Number
SRK 1CH008.009.500

July 2009

Hope Bay Mining Limited

Incinerator Management Plan

Hope Bay, Nunavut, Canada

Hope Bay Mining Ltd.

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1 Introduction

1.1 Reason for Submission

Hope Bay Mining Limited (HBML) is currently further developing the infrastructure for the Hope Mining Project in Hope Bay, Nunavut, Canada. Part of this infrastructure development is for the effective incineration of appropriate waste in accordance with the Water Licence No: 2AM-DOH0713 issued to HBML by the Nunavut Water Board (NWB).

HBML are required under the Type A Water Licence (Parts G) to submit to the NWB an Incineration Management Plan (Section 5) in conjunction with a revised Landfill Management Plan (Section 9). The plan, as defined in the License shall consider the following:

a) *Recycling/segregation waste program*
b) *Incineration technology selected*
c) *Waste audit – amount and types of wastes to be incinerated or otherwise disposed*
d) *Consolidation of wastes*
e) *Operational and maintenance records*
f) *Operator Training*
g) *Emission measurements*
h) *Incinerator Ash disposal*
i) *Consideration for disposal of used oil and waste fuel*
j) *Monitoring, characterization, and disposal of incinerator ash.*

This Incinerator Management Plan has been prepared and is being submitted by Hope Bay Mining Limited to address the requirement specified in Part G, Section 5 of the Water Licence No: 2AM-DOH0713. The plan addresses all relevant aspects of the operation, maintenance and monitoring of the Westland Model CY-100-CA-D-O incinerator located at the Roberts bay site, and the management of all residual materials (ash) generated by the operation of the incinerator. This incinerator services the Doris North Camp.

1.2 Project Location

The Hope Bay Gold Mining Project located on Inuit Owned Land in the West Kitikmeot region of Nunavut approximately 125 km southwest of Cambridge Bay and 75 km northeast of Umingmaktok (Figure 1). The various elements of Hope Bay Project are centred at approximately 680 09' N and 1060 40' W and extend from the head of Roberts Bay (an extension of Melville Sound) in the north to the Boston site located approximately 70 km to the south (Figure 1).

1.3 Incinerators at Hope Bay

There are currently two incinerators at the Doris North Project at Hope Bay. The location, operational state and model type of the incinerators are identified below and in Figure 2.

- Doris Camp incinerator is located at Roberts Bay at: N 68 10.470' W 106 37.111' (In service) (Model CY 100- CA- D-O) (Dual Chamber)

- Incinerator at Roberts Bay Roberts Bay, Coordinates: N 68 10.476' W 106 37.322' (Not in service) (Model CY-1020 FA).

1.4 Operator

The Hope Bay Project is owned and operated by:

Project Operator: Hope Bay Mining Ltd.
Suite 300 -899 Harbourside Drive
North Vancouver, B.C. V7P 3S1

Hope Bay Project Contacts:

Corporate: Mr. William Patterson
Environmental Compliance Manager
Hope Bay Mining Ltd.
Tel. 303 837 5661

Hope Bay Site: Mr. Fred Penner
Site Manager
Hope Bay Mining Ltd.
Tel. 604 759 4708

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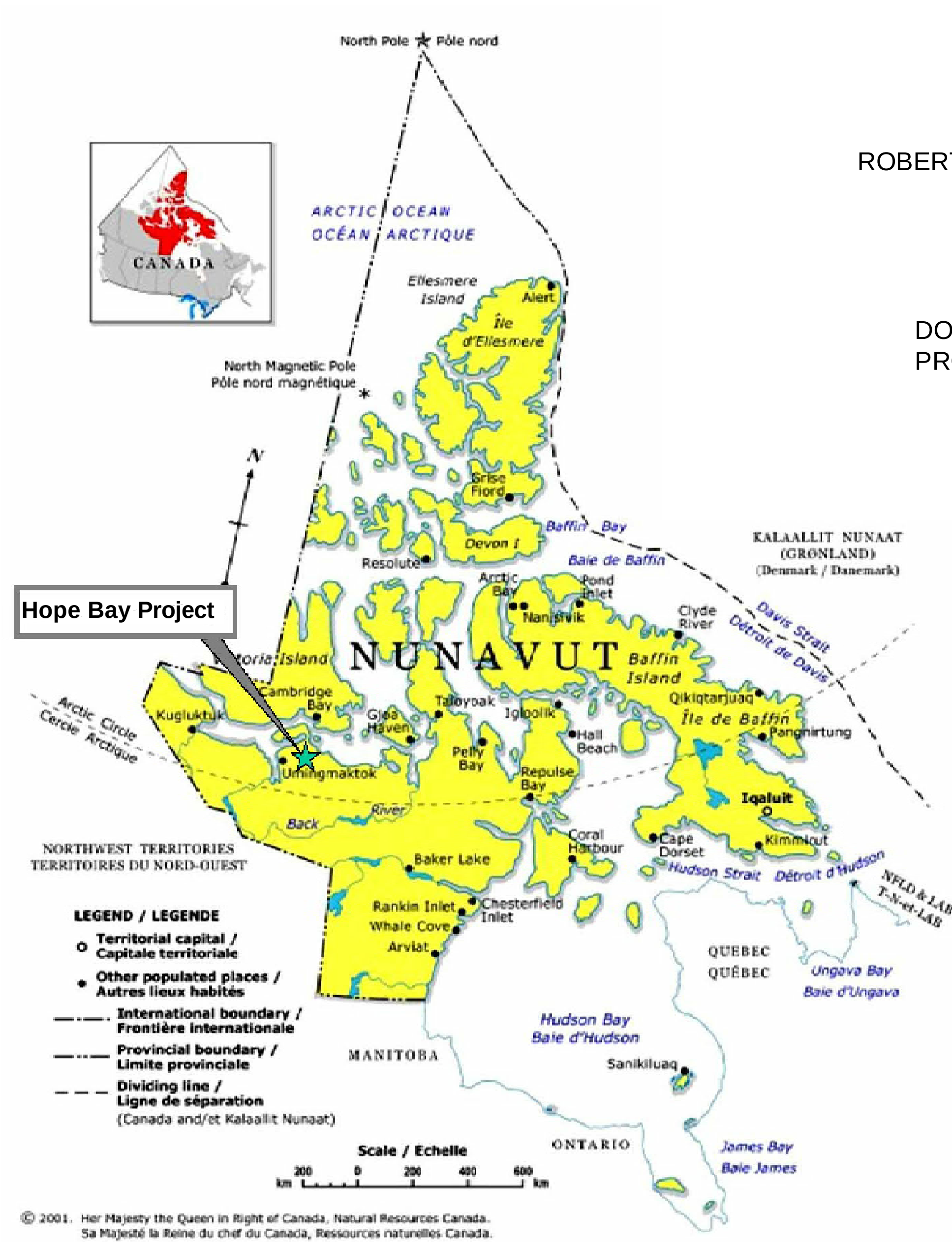
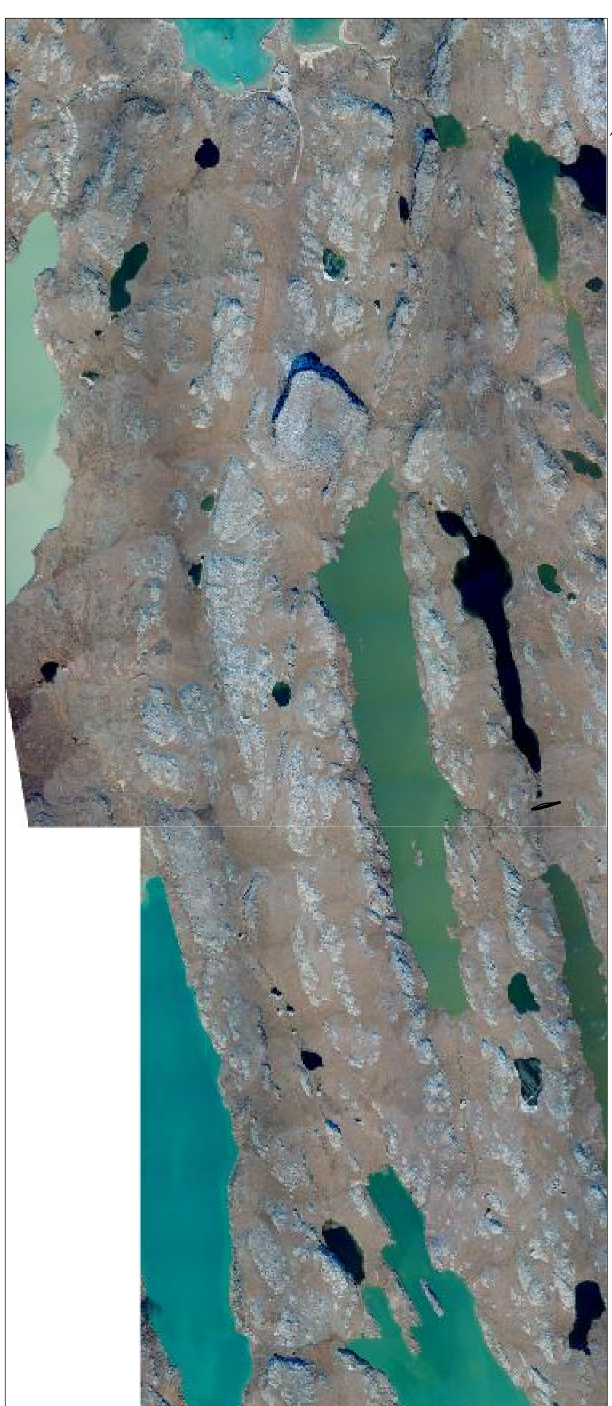
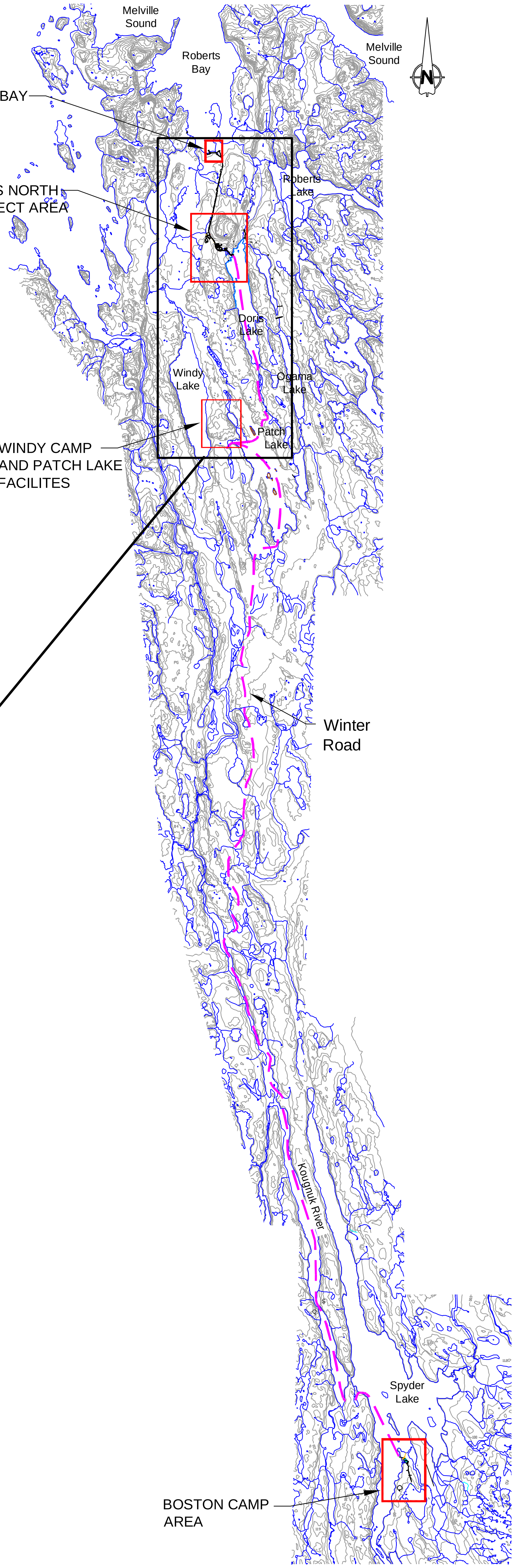


LOCATION MAP



ROBERTS BAY TO WINDY CAMP



Topographic Information Supplied by BHP World Minerals Inc.
National Topographic Series (NTS) Maps
North American Datum (NAD) 1927

SRK Consulting Engineers and Scientists Vancouver	HOPE BAY MINING LTD.	-
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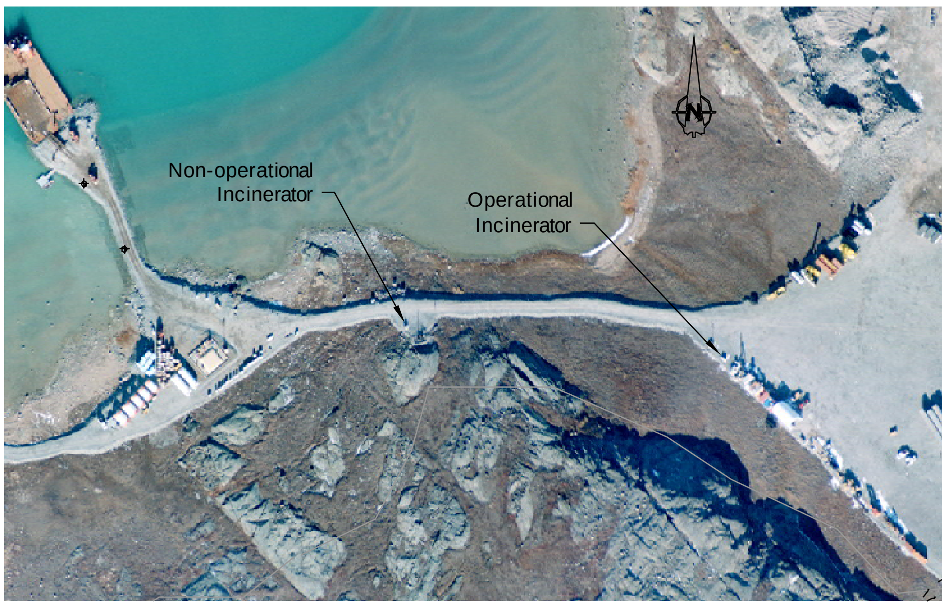
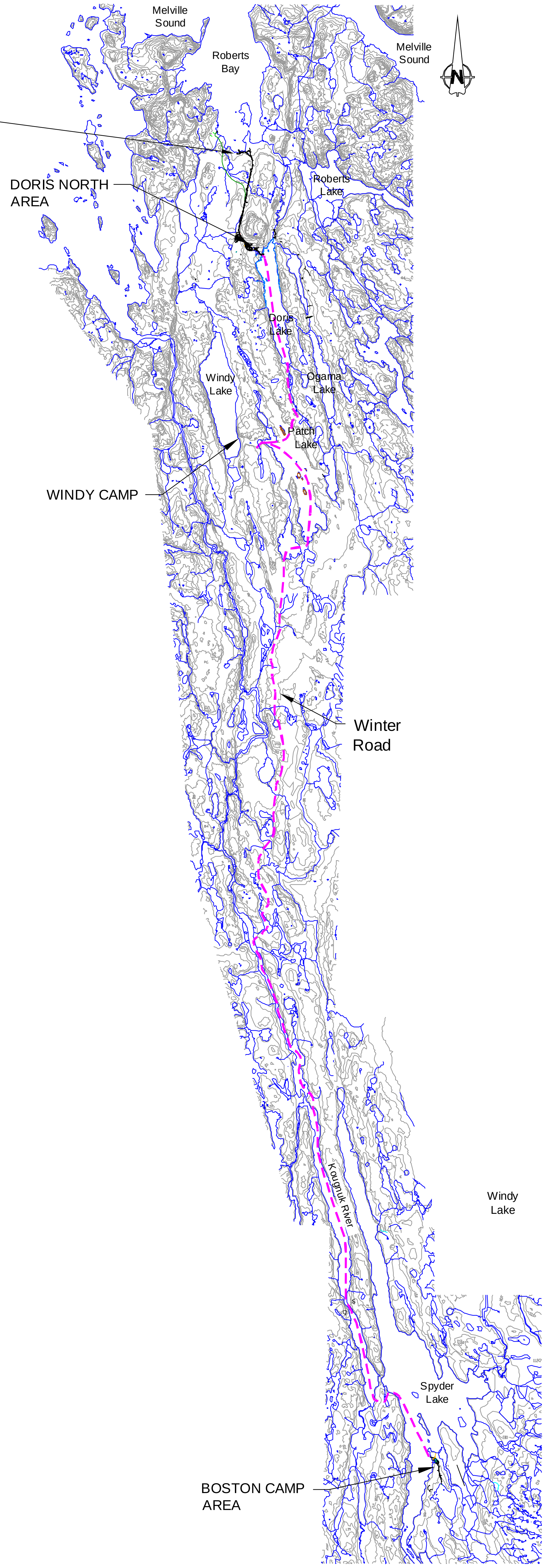


Roberts Bay Area



Topographic Information Supplied by BHP World Minerals Inc.
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North American Datum (NAD) 1927

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SRK JOB NO.: 1CH008.010-400	Hope Bay Project	Incinerator Locations		
FILE NAME: Incinerator Plan-1.dwg		DATE: June 2009	APPROVED: MV	FIGURE: 2

1.5 Plan Objectives

The objectives of managing and appropriate incinerations of wastes are numerous. Consistent with HBML's intent to be a responsible operator these objectives are described as follows:

- Compliance with regulatory and permit requirements
- Prevention of public health risk
- Protection of the operator
- Protection of surface water
- Protection of groundwater
- Protection of land
- Protection of local species
- Conservation of resources
- Protection of community amenity.

This Incinerator Management Plan has been developed to ensure that these factors are built into the HBML operational approach to working at Hope Bay.

1.6 History of Incinerator Management Plan

This, the Hope Bay mining Limited Incinerator Management Plan – Revision 0 will be reviewed on a regular basis (at least once per calendar year) and revised as required. Each revision will be recorded in Table 1.

Table 1: History of Incinerator Management Plan Revisions

Revision Number	Review Date	Description of Revisions	Revised By
0	May 2009	Initial issuance of Incinerator Management Plan	Not applicable

1.7 Responsibility

The Site Manager has overall responsibility for this management plan and will be the party to provide the resources to operate and maintain the Westland Model CY-100-CA-D-O Incinerator located at the Roberts Bay site. The Site Manager will have site responsibility for the implementation of this management plan and will be responsible to provide the on-site resources to operate, manage and maintain the Incinerator in accordance with the manual; conduct regular inspections of the incinerators; and provide input on modifications in design and operational procedures to improve operational performance of the facilities. The Site Manager, will provide daily supervision to site operational personnel on the operation of the incinerator.

The site Environmental Coordinator has responsibility to regularly review and keep this management plan up-to-date; provide technical expertise to the site operational personnel and maintenance of the incinerator, reporting on the performance of the incinerator, residuals (ash) management; conduct annual audits of the waste management and incineration; and provide an audit report to the Site Manager.

2 Applicable Legislation, Licensing and Guidelines

2.1 Water License

With regard to waste management and incineration, Part G of Water License No: 2AM-DOH0713 states:

5. The Licensee shall dispose of all food waste in an incinerator designed for this purpose.

6. The Licensee shall ensure that any on-site incinerator meets the requirements of the Canada-Wide Standards for Dioxins and Furans and Canada-Wide Standards for Mercury Emissions.

7. The Licensee shall submit to the Board for review by May 1, 2008 an Incineration Management Plan in conjunction with Part G, Item 9.

8. The Licensee is restricted to the open burning of paper products, paperboard packing and untreated wood waste in accordance with the Government of Nunavut policy Municipal Solid Wastes Suitable for Open Burning.

9. The Licensee shall submit to the Board for review by May 1, 2008, a revised Landfill Management Plan. The Plan shall consider the following:

Recycling/segregation waste program:

a) Incineration technology selected
b) Waste audit – amount and types of wastes to be incinerated or otherwise disposed
c) Consolidation of wastes
d) Operational and maintenance records
e) Operator Training
f) Emission measurements
g) Incinerator Ash disposal
h) Consideration for disposal of used oil and waste fuel
i) Monitoring, characterization, and disposal of incinerator ash.

10. The Licensee is authorized to dispose of and contain all non-hazardous solid wastes at the Landfill or as otherwise approved by the Board.

2.2 Canada-Wide Standards for Dioxins, Furans and Mercury

Canada has identified dioxins, furans and mercury as emission products that need to be controlled as they pose a potentially significant health and environmental threat. This section presents an extract of the Canada Wide Standards which are made available in full in Appendix A and B.

2.2.1 Dioxin and Furans

Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs), commonly known as dioxins and furans, are toxic, persistent, bioaccumulative, and result predominantly from human activity. Due to their extraordinary environmental persistence and capacity to accumulate in biological tissues, dioxins and furans are slated for virtual elimination under the *Canadian Environmental Protection Act* (CEPA), the Federal *Toxic Substances Management Policy (TSMP)* and the CCME *Policy for the Management of Toxic Substances*.

Dioxin and furan contamination found in soil, water, sediments, and tissues (in situ contamination), is the subject of national guidelines for dioxins and furans. These guidelines outline ambient or "alert levels" which may be used by jurisdictions as benchmarks for the management and monitoring of dioxins and furans already present in the environment.

The Canada-wide Standards process has focussed on anthropogenic sources that are releasing dioxins and furans to the atmosphere and soil in a continuous process. Waste incineration has historically been responsible for a significant portion of the dioxins and furans emitted in Canada. The total release of dioxins and furans from this sector amounts to 44.9 g/ TEQ/y or 22.5% of the total releases to the atmosphere. Improved exhaust gas controls to reduce emissions of acid gases and fine particulates or activated carbon injection systems have decreased emissions of both mercury and dioxins and furans from the municipal solid waste (MSW) sector.

The following standards are a step towards achieving virtual elimination for dioxins and furans. For new or expanding facilities of any size, application of best available pollution prevention and control techniques, such as a waste diversion program, to achieve a maximum concentration[1] in the exhaust gases from the facility as follows:

- Municipal waste incineration 80pg I-TEQ/m^3
- Medical waste incineration 80pg I-TEQ/m^3
- Hazardous waste incineration[2] 80pg I-TEQ/m^3
- Sewage sludge incineration 80pg I-TEQ/m^3

For existing facilities application of best available pollution prevention and control techniques, to achieve a maximum concentration[1] in the exhaust gases from the facility as follows:

- Municipal waste incineration:
  > 26 Tonnes/year 3 80pg I-TEQ/m^3
  < 26 Tonnes/year 4 80pg I-TEQ/m^3
- Medical waste incineration:

[1] Stack concentrations of dioxins and furans will be corrected to 11% oxygen content for reporting purposes.
[2] Hazardous waste incinerators include all facilities that burn hazardous waste including low level radioactive waste; however they do not include facilities that use waste derived fuel or used oil.

> 26 Tonnes/year3 80pg I-TEQ/m^3
< 26 Tonnes/year4 80pg I-TEQ/m^3

- Hazardous waste incineration 2 80 pg I-TEQ/m^3
- Sewage sludge incineration 100 pg I-TEQ/m^3

Any new or expanding facility will be required to design for and achieve compliance immediately upon attaining normal full scale operation, compliance to be confirmed by annual stack testing. Based on determined efforts in working towards virtual elimination, existing facilities will be required to meet the standards on the following schedule:

- Municipal waste incineration 2006
- Medical waste incineration 2006
- Hazardous waste incineration 2006
- Sewage sludge incineration 2005

In addition to the continuing efforts of waste incinerator operators to destroy or capture emissions of dioxin and furans, emphasis will be placed on identifying and implementing opportunities to prevent the creation of dioxins and furans as well as emissions of air pollutants and ash quality generally. As an initial action with shared responsibility by all jurisdictions, strategies identifying opportunities to minimize waste incineration emissions of air pollutants including dioxins and furans will be developed through a multi-stakeholder process by December 31, 2001 to provide a framework for continual progress towards the elimination of dioxin and furans. Recognizing that many opportunities for minimizing air pollutant and ash emissions and specifically avoiding the creation of dioxins and furans fall beyond the exclusive influence of the operators of waste incinerators, preparation of this strategy must engage a wide range of stakeholders.

2.2.2 Mercury

Waste incineration has historically been responsible for a significant portion of the mercury emitted in Canada, however reductions in emissions have been apparent. Improved exhaust gas controls to reduce emissions of acid gases and fine particulates or activated carbon injection systems have decreased emissions of both mercury and dioxins and furans from the municipal solid waste[4] sector. At the same time, action has been taken by many product manufacturers to reduce the mercury content of consumer goods which could end their life cycle in domestic solid waste (e.g., alkaline batteries) and thus have reduced the mercury available in the waste stream. Mercury from this sector is estimated to be 446 kg/year. Many medical waste incinerators[5] have closed for economic or environmental reasons, but a range of medium- to small-sized facilities remain which alone are small sources, but as a sector are considerable, emitting an estimated 250 kg/yr. Two sectors in which emission reductions are not apparent, hazardous waste[6] (550 kg/yr) and sewage sludge (285 kg/yr) incineration, can achieve reductions either through source control or gas-controls.

Emission limits are expressed as a concentration in the exhaust gas exiting the stack of the facility. New or expanding facilities will be expected to comply immediately with the standard, and it will be up to individual jurisdictions to determine what constitutes a significant expansion to trigger the standard. The limits for existing facilities are capable of being met using generally available technology (or waste diversion). Larger facilities will be subject to annual stack testing to verify compliance with the limit and smaller (medical, municipal) facilities will have the option of reporting on a successful mercury diversion plan or of conducting a one-time stack test, to illustrate progress towards the standard.

For new or expanding facilities of any size, application of best available pollution prevention and control techniques, such as a mercury waste diversion program, to achieve a maximum concentration in the exhaust gases from the facility as follows:

- Municipal waste incineration 20 µg/Rm^3
- Medical waste incineration 20 µg/Rm^3
- Hazardous waste incineration 50 µg Rm^3
- Sewage sludge incineration 70 µg/Rm^3

For existing facilities application of best available pollution prevention and control techniques, to achieve a maximum concentration in the exhaust gases from the facility as follows:

- Municipal waste incineration
  $>$ 120 Tonnes/year 9 20 µg/Rm^3
  $<$ 120 Tonnes/year10 20 µg/Rm^3
- Medical waste incineration
  $>$ 120 Tonnes/year 9 20 µg/Rm^3
  $<$ 120 Tonnes/year10 40 µg/Rm^3
- Hazardous waste incineration 50 µg/Rm^3
- Sewage sludge incineration 70 µg/Rm^3

Stack concentrations of mercury will be corrected to 11% oxygen content for reporting purposes.

Timeframe for achieving the targets are defined as any new or expanding facility will be required to design for and achieve compliance immediately upon attaining normal full scale operation, compliance to be confirmed by annual stack testing or an equivalent emission rate as confirmed by an audit of a waste diversion program.

Existing facilities will endeavour to meet the standards on the following schedule:

- Municipal waste incineration 2006
- Medical waste incineration 2006
- Hazardous waste incineration 2003
- Sewage sludge incineration 2005

2.2.3 Waste Management under the CWS

Canada has also recognized that to minimize air pollutant and ash emissions the best strategy is to specifically avoiding the creation of dioxins and furans. Various mechanisms to give effect to the reduction are:

- Waste diversion to minimize generation of waste
- Waste reduction
- Material reuse
- Waste segregation
- Combustion control
- Alternative disposal or treatment technologies.

2.2.4 Water License Emission Testing Requirements

The following parameters are required to be monitored based on the conditions specified in the water licences:

- Dioxin
- Furan
- Mercury emissions
- Vol. Flow rate (out of stack)
- Stack gas Temp
- Moisture content.

Optional:

- SO_2
- NO_2
- O_2
- Particulates.

3 Waste Management at Hope Bay

Waste at Hope Bay is currently handled and processed in a variety of ways, with all resulting in material being backhauled to Yellowknife for disposal. This is not necessarily an ideal situation as there is a significant environmental and economic cost to hauling waste. To be consistent with the Canada Wide Standards (CWS) presented above, opportunities for local processing of waste at Hope Bay should be investigated. This includes the composting of vegetable matter from kitchens, if it can be shown not to attract bears, and UV processed sewage sludge. These two components represent the bulk of the material that needs to be incinerated and also a potential source of dioxins, furans and mercury which cannot easily be diverted from the incineration process. The water licence however requires all food waste to be incinerated, which is directly at odds with the requirement of the CWS. The reduction of the volumes of waste that need incineration and maximising the amount of waste that can be processed via composting on site would be the ideal for waste management.

The sewage management plans that have been prepared for Hope Bay also identify compositing of sewage sludge as a key opportunity for the management of waste. Furthermore there is untreated wood waste which is currently being backhauled to Yellowknife. This wood could be chipped and added to the composting process to increase the cellulose content of the compost. This would create a ready supply of compost for the future remediation of areas that have been disturbed. The potential for composting has been confirmed in Northern areas by work done in Iqaluit my Mr Jim Little and reported by the Composting Council of Canada. In their test composting schemes they achieved temperatures of 59°C in summer, which is adequate to destroy many of the harmful pathogens. This temperature would probably be higher with an increased cellulose load. The heat makes the composting season longer than just the short summer period and creates the opportunity for using the heat in space heating.

In order to minimise volumes of waste in all parts of the life cycle and reduce the potential for it to cause harm in processing or transport, the following is recommended but may require changes to the water license and operations at Hope Bay:

Waste Minimisation

- Reduction of packaging sent to Hope Bay
- Use of bulk supplies only
- Use of non PVC based medical devices

Composting

- Vegetable based food waste
- Sewage sludge
- Untreated wood waste

Incineration

- Medical waste (Minimising plastics and PVC)
- Sewage course filter
- Meat and bone products from food supply

Waste Backhaul, Recycling and Disposal

- All metal waste (Recycle)
- All glass waste (Recycle)
- All painted or treated wood waste (Dispose)
- All plastic materials (Especially PVC) (Recycle/Dispose)
- All hazardous chemical waste (Dispose)
- All used hydrocarbons (Oils etc) (Process)
- All contaminated soil material (Remediate).

The broad philosophy underpinning the management of Waste at Hope Bay is:

- **Eliminate non useable goods:** Prevent non useable material from being sent to Hope Bay
- **Reduce waste volumes:** Bulk supply tends to reduce the amount of waste from packaging
- **Recycle products on-site:** Find second life for packaging items etc on site
- **Recovery of Waste:** On-site composting etc
- **Process hazardous and non compostable waste:** Incineration on-site and backhauling for safe disposal and recycling.

Hope Bay Mining Limited are in the process of producing a more comprehensive Waste Management Plan for the site. This is an extract from that document. The Waste Management Plan is not repeated here, although incineration forms a key part of the current waste management strategy.

Waste management is an important part of maintaining a high level of performance in operations and to ensure this for incinerator operations, Hope Bay Mining Limited has had the supplier of the equipment train all operators. The training has been focussed on explaining the principles of incineration as well as the safe and efficient operation of the incinerators.

4 Hope Bay Incinerator Emission Management

Incineration is essentially combusting material (thermal oxidation) under controlled conditions so as to render it less harmful and reduce volume by on average 95%. During combustion to ash, potentially harmful medical waste and sewage sludge can be sterilized and eliminated, medical sharps eliminated and the general waste significantly reduced in volume. The main products of incineration are:

- Heat
- Ash
- Gaseous emissions.

Incineration was initially considered to be an elegant solution to waste problems, but as understanding has grown, it has become apparent that both the ash and gaseous emissions can have potentially negative impacts as well as pose a health risk. This section of the incinerator management plan has been developed so the potential risks can be understood and that the information can be used to better manage the incinerators and waste at Hope Bay.

4.1 Ash Management

Ash from waste incinerators is known to contain heavy metals and potentially dioxins and furans. The ash at Hope Bay is placed into drums, sealed and transported to Yellowknife for safe disposal at a permitted hazardous waste landfill site. In Appendix C, waste manifests of this disposal are provided.

In essence the only way to improve the ash composition is to remove items that are not wanted as residuals in the ash. To reduce the ash volume incineration volume needs to be reduced. Both these options are explored in greater detail below.

4.2 Emission Management

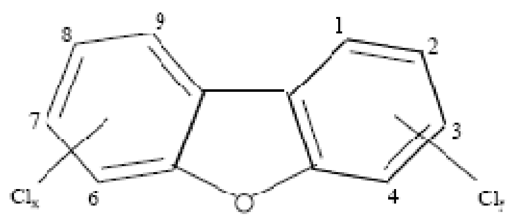
Dioxins and Furans are some of the most dangerous by-products of incineration and can occur in waste ash as well as emission products from incinerators. Understanding how they are formed and how they can be minimised is an important part of incinerator management. The term “dioxins” refers to the family of compounds comprising polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) and are frequently grouped together simply as dioxins.

Dioxin and furan control is important to minimise the potential health effects of incinerator operation, but analytical costs are high, so most operators only conduct testing where it is a regulatory requirement. Air emissions are most frequently monitored, but incineration waste streams such as the bottom ash, scrubber sludge, fly ash material and wet scrubber effluent discharged to sewer may also contain dioxins and furans. Due to the cost involved in monitoring the dioxins and furans, the focus is frequently placed on minimising their formation by careful operational control and careful waste separation to eliminate products that tend to increase the availability of catalysts and chlorine compounds.

4.2.1 Description of Dioxins and Furans

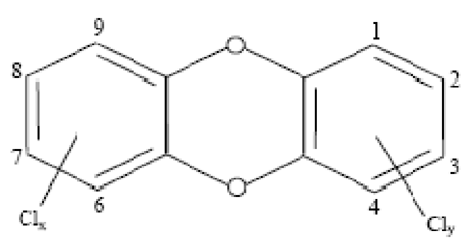
Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) are a group of tricyclic aromatic hydrocarbons substituted with one to eight chlorine atoms. These compounds, commonly known as 'dioxins' or 'dioxins and furans', are found virtually everywhere on earth, with the main transport mechanism being atmospheric dispersion and deposition.

In molecular structure, a dioxin consists of two benzene rings connected by a pair of oxygen atoms and a furan consists of two benzene rings connected by a single oxygen atom and a C-C bond. Each of the eight carbon atoms on the rings that is not bonded to an oxygen atom or another carbon atom can bond with atoms of other elements. By convention these positions are assigned the numbers 1 through 4 and 6 through 9. PCDDs and PCDFs are bonded with 1 - 8 chlorine atoms. Figure 3 and Figure 4 show the molecular structures of PCDDs and PCDFs, respectively.



X = 0 to 4, Y = 0 to 4, X + Y ≥ 1

Figure 3: Molecular structure of Polychlorinated Dibenzo-p-Dioxins (Unilabs)



X = 0 to 4, Y = 0 to 4, X+ Y ≥ 1

Figure 4: Molecular structure of Polychliorinated Dibenzofurans (Unilabs)