installed and operated according to the "Protocols and Performance Specifications for Continuous Monitoring of Gaseous Emissions from Thermal Power Generation" Report EPS 1/PG/7 (revised 2005) provided by the Federal Environmental Protection Service.

5.3.1.3 CO, CO_2, Halogens, PM, SO_2, Trace Elements

In order to provide representative current emission rates for the air quality assessment, source (stack) testing was conducted on Brandon G.S. Unit 5. One of the other objectives of the source testing is to compile data related to various reporting requirements. The results of the source testing were used to update the station air emissions of COPCs.

Air emission data are reported to a number of regulatory and related agencies, including: Manitoba Conservation, Environment Canada, Statistics Canada, and the Chicago Climate Exchange.

5.3.2 EMISSIONS MITIGATION

5.3.2.1 NO_x

NO_x emissions from the Unit 5 boiler are largely dependent on the configuration of fuel (pulverised coal) and oxygen supply to the boiler. As described in Section 2.7.1.1, various boiler burner combinations can usually be selected by station operators; exceptions would be when there are mechanical problems. The most efficient combination of burners is the preferred operating configuration. The preferred burner configuration yields NO_2 emissions[15] that are 24 percent lower than the least efficient configuration; the resulting predicted maximum 1-hour average ground-level NO_2 concentration is 25 percent lower.

Historically, Unit 5 operates in the most efficient mode 60 percent of the time and in the least efficient mode 10 percent of the time. This ratio is not expected to change. A procedure is in place at the station to make the most efficient combination of burners the default operational configuration.

5.3.2.2 Trace Contaminants

Emission of SO_2 and various elements, such as trace metals, are largely dependent on coal chemistry; for example the greater the coal sulphur content, the greater the SO_2 emissions. Coal chemistry can vary significantly from mine-to-mine. As part of this environmental impact assessment, Manitoba Hydro completed a comprehensive review of coal chemistry and associated environmental significance to the operation of Brandon G.S. Unit 5.

The objective of this review is to provide an environmental ranking of coals from various suppliers and to screen out sources of coal that produce unacceptable emissions. The environmental ranking is based on the effects of potential air contaminant emissions from Unit 5. The preferred coal sources are those which would maintain or reduce emissions of four key contaminants relative to current Unit 5 emissions produced from combustion of Montana's Spring Creek mine coal. These four contaminants are: mercury (Hg), selenium (Se), sulphur dioxide (SO_2), and particulate matter (PM). Secondary consideration is also given to the potential effect on emissions of other coal trace contaminants. Coals from a large number of mines were considered in the analysis.

[15] Assuming 100% conversion of NO to NO_2.

As a result of the analysis, a number of environmentally-preferred mines were identified as providing suitable future coal supplies for Unit 5. Manitoba Hydro will only purchase coal from these mines, or mines that offer coals with similar characteristics to ensure this environmental assessment remains applicable during the future operation of Unit 5. Manitoba Hydro will screen any new coal sources using this environmental ranking methodology to ensure they are acceptable for use at Brandon G.S. Unit 5.

5.3.2.3 Suspended Particulate

To mitigate fugitive suspended particulate (dust) emissions from coal handling equipment Brandon G.S. is reviewing equipment additions that will increase the wetting capabilities in the coal handling area.

Modifications have recently been made at the coal belt transfer points by installing new impact beds. In addition, the internal dust collection system has been improved. Brandon G.S. has an operating procedure that empowers the coal crew to suspend coal handling operations when fugitive dust emissions are crossing the property boundary.

Fugitive emissions from the ash lagoon will be mitigated in 2007 by a works program to cap the west cell. Preliminary work completed in 2006 includes placing and contouring the ash in advance of the capping program.

5.3.2.4 Greenhouse Gases

It has been anticipated that after 2007 Canada would adopt mandatory GHG reporting and management requirements for GHG producing corporations in certain industry sectors in Canada. In the absence of GHG regulations, Manitoba Hydro has been committed to voluntarily reducing average corporate GHG emission to 6% below 1990 levels in the 1991 to 2007 period. Refer to Appendix M - Manitoba Hydro's 2005 GHG Summary, for more details.

Manitoba Hydro will continue to manage its GHG emissions, including emissions from Unit 5, on a voluntary basis until such time as a mandatory system is implemented. The implementation of federal regulations will supersede Manitoba Hydro's current voluntary commitment. Under the anticipated requirements, Electrical Power Generation (EPG) sector utilities would be expected mitigate their corporate GHG emissions to predetermined levels; Unit 5 emissions would be included in this requirement. Should the implementation of federal GHG reporting and management regulations be delayed beyond 2007, Manitoba Hydro will continue to manage its emissions on a voluntary basis until such time as mandatory regulations are introduced.

5.3.2.5 Mercury

Canadian mercury emissions have been the focus of increased regulatory scrutiny since the endorsement of the "Canada-wide Standards for Mercury Emissions" in 2000 by the Canadian Council of Ministers of the Environment (CCME). In 2005, the CCME agreed in principle to establish mercury Canada-wide Standard (CWS) for the electric power generation (EPG) sector. The goal of the standard was to reduce mercury air emissions from existing plants and ensure that new plants achieve emission levels based on best available technologies, economically available, or equivalent. The standard establishes a target of

provincial caps for mercury air emissions from existing, coal-fired, EPG plants. The proposed, provincial caps will be implemented in 2010 and will represent a national, mercury capture target of 65%.

The CWS is to be implemented and enforced across Canada by the various provincial jurisdictions in accordance with their own provincial laws. In implementing the standards, provincial governments may choose to use their existing legal authorities, or create new ones, if necessary. In Manitoba's case, inclusion of a "mercury emission cap" condition within the framework of an updated Environment Act Licence for Brandon Unit 5 would meet the intent of the CWS.

As Brandon Unit 5 is Manitoba's only operating coal-fired electric power generating unit, the 2010 provincial mercury cap of 20 kg/year would apply to Unit 5 alone. The 2002 Selkirk Generating Station fuel-switch has been recognized by the CCME as an eligible, early action supporting the intent of the CWS and has been taken into consideration in the setting of the 20 kg/year annual cap.

Prior to implementation of the CWS mercury cap in 2010, Manitoba Hydro has committed to voluntarily begin limiting mercury air emissions to 20 kg per year as of 2006. This was communicated to Manitoba Conservation in September of 2006. At 20 kg/year, the contribution of Unit 5 mercury emissions to total mercury deposition in the region represents approximately 2-4% of total mercury deposition from all global sources.

5.4 ENVIRONMENTAL AND HUMAN HEALTH RISK ASSESSMENT

5.4.1 SUMMARY

In order to assist in the interpretation of the overall impact of continuing operation of the station, potential health and ecological effects to people and ecological species located in the immediate area surrounding the Brandon G.S. were evaluated. A summary of this risk assessment is provided below. The full text of the assessment is found in Appendix N (Human Health and Ecological Risk Assessment) of this report.

The human health and ecological risk assessment was used to interpret the potential adverse effects of coal-fired operation of Unit 5 at the Brandon G.S. The chemicals of potential concern (COPC) identified were combustion gases (carbon monoxide, nitrogen oxides, and sulphur dioxide), volatile organic compounds, trace metals and other inorganic elements, polycyclic aromatic hydrocarbons (PAHs), dioxins and furans, and particulate matter.

Short-term health effects were evaluated based on short-term exposure to Unit 5 emissions at the maximum sustained generation rate (105 MW) for the facility. Long-term rates of exposure and potential health effects on various individuals (human receptors) considered representative of the community located in the immediate area surrounding Brandon G.S. were conservatively estimated assuming a 100% capacity factor (C.F.), even though actual operation of Unit 5 is likely to be much lower. Adverse effects on ecological receptors near Brandon G.S. were also determined using the 100% C.F.

The methodology used in assessing human health risks followed guidelines outlined by various regulatory agencies including Environment Canada, Health Canada, the Canadian Council of Ministers of the Environment (CCME), and the United States Environmental Protection Agency . Results are expressed in terms of hazard quotients and cancer risk levels for long-term exposures and in terms of concentration

ratio values for short-term exposures. The hazard quotient is defined as the ratio of exposure to a long-term toxicity value and the concentration ratio is defined as the ratio of the predicted concentration to a short-term concentration protective of human health. In general, Health Canada concurs that a hazard quotient below 0.2, or an incremental cancer risk level equal to or less than one-in-one hundred thousand ($<1 \times 10^{-5}$), is not significant. For short-term exposure, concentration ratios below 1 are not considered significant. Values below these regulatory limits were interpreted as reflecting no significant adverse health effects.

The potential exposure pathways for human receptors were assumed to include the inhalation of particulate matter and gaseous particles outdoors, the ingestion of soil and dust outdoors and the ingestion of locally (backyard garden) grown produce as well as ingestion of beef and cow's milk as seen in Figure 5-29. It was assumed that drinking water was from a municipal source not iaffected by emissions from Unit 5. Specific assumptions for each receptor location are outlined in Table 3.2-2 of Appendix N. The pathways are described in more detail below.

As discussed above, the various pathways evaluated were as follows:

- Inhalation of Air: The emission of small amounts of chemicals of concern from the coal-fired operation at the Brandon G.S. will result in the direct exposure of the human population as the plume impinges down onto the ground level. Human receptors will therefore inhale both gaseous and particle-borne chemicals while outdoors.
- Inhalation of Soils and Dusts: Human exposure may occur through inhalation of soils and dusts outdoors as the gaseous and particle-borne chemicals deposit onto soils and surfaces. The rate of this deposition is a function of the local meteorological conditions such as wind speed and precipitation rates.
- Ingestion of Locally Grown Produce: As chemicals are deposited from air-borne emissions, they may contact leaves and fruit of locally grown (backyard gardens) produce, where they may remain on the surface or may be absorbed into the station. Deposition of chemicals onto the soil may also result in accumulation in plants via root uptake. Humans are exposed to these chemicals by eating the produce from their backyard gardens. Cows are also exposed by grazing on potentially contaminated vegetation. Humans are then exposed by consumption of locally grown beef and milk.
- Ingestion of Breast Milk: It is assumed that infants in residences around the Brandon G.S. would be exposed to chemicals via the breast milk of their mothers. It is assumed that the mothers would be exposed to the chemicals of concern via the consumption of locally grown produce as well as the inhalation of air and ingestion of soil and dust. This exposure pathway was only assessed for chemicals of concern with $\log K_{ow} > 4$. Only benzo(a)pyrene falls into this category and will only be assessed at the receptor location where the maximum point of impingement occurs. Any other receptor location would result in a much lower exposure.
- Ingestion of Soils and Dusts: Human exposure may occur through ingestion of soils and dusts outdoors as the gaseous and particle-borne chemicals deposit onto soils and surfaces.
- Dermal Exposure to Soils and Dusts can be a pathway of exposure; however, soil concentrations in this assessment are very low and thus dermal exposure will be limited. Therefore, this pathway was not considered in the assessment.

Nine locations plus the maximum point of impingement (POI) were chosen for receptors that are most likely to be affected by the emissions from Unit 5 at the Brandon G.S. These locations are representative of a range of different exposure scenarios. These receptor locations are shown in Figure 5-30. The POI location was chosen to ensure that the maximum exposure related to Unit 5 operation was captured in the assessment of short-term effects. Four categories of human receptors were selected (resident, industrial worker, school, and hospital/health centre patient) to evaluate long-term exposures; only adult and composite receptors (an individual present at that location all their life) were considered in the assessment as only carcinogenic COPC were being evaluated.

5.4.2 HUMAN HEALTH ASSESSMENT

5.4.2.1 Short-term Effects from Exposure to Combustion Gases

As indicated in Tables 5-11 and 5-12, potential short-term effects (e.g., respiratory health effects) arising from Unit 5 emissions at the Brandon G.S. were shown to be below the *a priori* concentration ratio of 1 as compared to short-term health values (see Table 5.1-2 in Appendix N). These concentration ratios include background. For the 1-hr NO_2 concentration, a realistic estimate is considered to be that which is based on the Janssen equation (see Section 5.2.3 of the EIS and Appendix K), which results in a maximum predicted 1-hour average NO_2 concentration plus background of 221 µg/m^3. This is slightly above the World Health Organization (WHO) Health Guideline (200 µg/m^3), but below the Manitoba Maximum Acceptable Objective of 400 µg/m^3. It should be noted that the background concentration used in the calculation is the average of the maximum measured annual NO_2 concentration from 2000-2004. Given the conservative assumptions used in the estimates of emissions from Unit 5 at the Brandon G.S., it is unlikely that adverse health effects would occur. Nevertheless, Manitoba Hydro will continue to use operating practices that minimize NO_x emissions.

Similarly, most of the concentration ratios for combined emissions from Unit 5 and Units 6&7 are below 1 (see Table 5-12), except for 1-hr NO_2 where the ratio exceeds a value of 1. Based on the Janssen equation, the maximum predicted 1-hour average NO_2 concentrations plus background levels would result in a concentration of 221 µg/m^3. This value is identical to the value for the emissions from Unit 5 alone because the maximum predicted concentrations due to Unit 5 do not occur in the same location as the maximum predicted concentrations from Units 6&7. As noted above, the maximum predicted 1-hour average NO_2 concentration of 221 µg/m^3 is slightly above the WHO Health Guideline (200 µg/m^3), but below the Manitoba Maximum Acceptable Objective of 400 µg/m^3. Therefore, this evaluation indicates that the emissions from the combined operation of Unit 5 and Units 6&7 at the Brandon G.S. are also unlikely to cause adverse health effects. Nevertheless, Manitoba Hydro will continue to use operating practices that minimize NO_x emissions.

For SO_2 emissions, the concentration ratios of predicted SO_2 concentrations were shown to be less than 1. Manitoba Hydro will ensure that this remains so into the future through the selective purchase of coal supplies with sulphur content that will not cause SO_2 emissions to increase to unacceptable levels.

Table 5-11 Potential Short-Term Concentration Ratios for the Combustion Gases at the Maximum Point of Impingement (Including Background)

Emission		Regulatory Jurisdiction	Maximum Concentration from Unit 5 ($\mu g/m^3$)	Regulatory Objectives ($\mu g/m^3$)	Concentration Ratio
OS1 - Current Coal Source with Burner Row Combination B,C,D					
CO	1-hr	Manitoba	4534	35,000	0.13
		WHO		30,000	0.15
	8-hr	Manitoba	2465	15,000	0.16
		WHO		10,000	0.25
NO_2 *	1-hr	Manitoba	193	400	0.48
		WHO		200	0.97
	24-hr	Manitoba	63	200	0.32
		WHO		200	0.32
NO_2 **	1-hr	Manitoba	345	400	0.86
		WHO		200	1.73
	24-hr	Manitoba	62	200	0.31
		WHO		200	0.31
SO_2	1-hr	Manitoba	190	900	0.21
		WHO		350	0.54
	24-hr	Manitoba	13.9	300	0.05
		WHO		125 (Interim)	0.11
		WHO		20	0.70
OS2 - Current Coal Source with Burner Row Combination A,B,C					
CO	1-hr	Manitoba	4537	35,000	0.13
		WHO		30,000	0.15
	8-hr	Manitoba	2466	15,000	0.16
		WHO		10,000	0.25
NO_2 *	1-hr	Manitoba	221	400	0.55
		WHO		200	1.11
	24-hr	Manitoba	64.4	200	0.32
		WHO		200	0.32
NO_2 **	1-hr	Manitoba	424	400	1.06
		WHO		200	2.12
	24-hr	Manitoba	78	200	0.39
		WHO		200	0.39
SO_2	1-hr	Manitoba	200	900	0.22
		WHO		350	0.57
	24-hr	Manitoba	14.6	300	0.05
		WHO		125 (Interim)	0.12
		WHO		20	0.73
OS3 - Future Coal Source with Burner Row Combination A,B,C					
SO_2	1-hr	Manitoba	265.5	900	0.30
		WHO		350	0.76
	24-hr	Manitoba	19.5	300	0.07
		WHO		125 (Interim)	0.16
		WHO		20	0.98

Note: - shaded value indicate concentration ratio exceeding the critical value of 1

- average CO background concentration in Winnipeg over 5 years (1999 – 2003)
- 1-hour ave. background NO_2: max. observed concentration over 5 years (2000-2004) minus max. predicted 1-hour ave. concentration for emissions from Unit 5 (see Appendix K) assuming 100 % NO to NO_2 conversion
- 24-hour ave. background NO_2: ave. of the max. measured background NO_2 concentration in Brandon over 2000-2004
- * Janssen method (see Appendix K)
- **assuming 100 % NO conversion to NO_2

Table 5-12 Potential Short-Term Concentration Ratios for the Combustion Gases at the Maximum Point of Impingement (Including Background) – Combined Unit 5 and Units 6&7 Operations

Emission		Regulatory Jurisdiction	Maximum Combined Concentration (Unit 5 and 6&7) from Brandon G.S. ($\mu g/m^3$)	Regulatory Objectives ($\mu g/m^3$)	Concentration Ratio
OS2-Current Coal Source with Burner Row Combination A,B,C + Units 6&7 Operations					
CO	1-hr	Manitoba	4710	35,000	0.13
		WHO		30,000	0.16
	8-hr	Manitoba	2525	15,000	0.17
		WHO		10,000	0.25
NO_2*	1-hr	Manitoba	221	400	0.55
		WHO		200	1.11
	24-hr	Manitoba	64	200	0.32
		WHO		200	0.32
NO_2**	1-hr	Manitoba	462	400	1.15
		WHO		200	2.31
	24-hr	Manitoba	78	200	0.39
		WHO		200	0.39

Note:
- shaded value indicate concentration ratio exceeding the critical value of 1
- average CO background concentration in Winnipeg over 5 years (1999 – 2003)
- 1-hour average background NO_2: maximum observed concentration over 5 years (2000-2004) minus maximum predicted 1-hour average concentration for emissions from Unit 5 (see Air Quality Assessment Report – Appendix K) assuming 100 % NO to NO_2 conversion
- 24-hour average background NO_2: average of the maximum measured background NO_2 concentration in Brandon over 5 years (2000-2004)
- * Janssen method. No direct NO_2 emission data were available for Units 6&7. With use of the Janssen method, it was assumed that 20 % of the direct NO_x emissions are NO_2, with the remaining 80 % as NO (see Air Quality Assessment Report – Appendix K, Section 5.6)
- **assuming 100 % NO conversion to NO_2

5.4.2.2 Long-term Effects from Exposure to Combustion Gases

The results of the assessment for long-term health effects associated with estimated exposure to the combustion gases produced by Unit 5 of the Brandon G.S. including background are presented in Table 5-13. The results are based on the OS3 scenario which results in the highest emission rates. In this

scenario, the assumption is that the facility will use coal with no more than 33 % higher sulphur content than what is presently used.

Table 5-13 Potential Chronic Concentration Ratios for the Combustion Gases at the Maximum Point of Impingement –OS3 (Including Background)

	WHO Annual Guideline ($\mu g/m^3$)	Maximum Predicted Annual Average Concentration ($\mu g/m^3$)	Average Background Concentration ($\mu g/m^3$)	Concentration Ratio [(Max Brandon + Background)/Criteria]
CO	2,800	0.05	442[a]	0.16
NO_2[b]	40	0.87	11[c]	0.30
SO_2	n/a	0.71	na	na

Note: n/a – not available , na – not applicable
[a] average background concentration in Winnipeg over 5 years (1999 – 2003)
[b] assuming 100 % NO conversion to NO_2
[c] average background concentration in Brandon over 5 years (2000 – 2004)

As seen from the table, long-term concentration ratio values for all the combustion gases, including background levels measured in Winnipeg/Brandon, are below the concentration ratio of 1. These long-term concentrations are based on the maximum predicted annual average concentrations (at the maximum point of impingement) with Unit 5 operating at a hypothetical 100 % capacity factor. The highest concentration ratio (0.30) is obtained for NO_2. It should be noted that the WHO annual guidelines are based on the protection of the most sensitive individuals within a population. The WHO in their recent guideline for SO_2 (2005) indicated that an annual value for SO_2 is not necessary since compliance with the 24-hour guideline will assume low annual values. The predicted 24-hour SO_2 concentrations presented in Tables 5-11 and 5-13 above are below the most stringent SO_2 guidelines which implies that there should be no long-term adverse effects from exposure to SO_2. Therefore, no measurable adverse health effects would occur from long-term exposure to the combustion gases emitted from Unit 5 of the Brandon G.S.

5.4.2.3 Particulate Matter Effects

For fine particulate matter, the maximum point of impingement for 24-hour average concentrations occurs at the facility property line near the northwest corner of the station boundary. A secondary point of elevated concentration occurs within the City of Brandon. For the fugitive dust emissions from the coal storage area, the maximum 24-hour average and annual average concentrations occur at the facility property line on the south side of the station, while those for the ash storage area occur at the property line along the north boundary of the station, near the Assiniboine River.

Overall, the predicted adverse effects of $PM_{2.5}$ from coal-fired operations of Unit 5 at the Brandon G.S. are negligible (i.e., below the measurement capability of $PM_{2.5}$ monitors). At the maximum point of impingement, the highest predicted 24-hour average $PM_{2.5}$ concentration due to emissions from the Brandon G.S. Unit 5 stack is 0.5 $\mu g/m^3$. The maximum $PM_{2.5}$ concentration measured at the Assiniboine Community College in Brandon over the period 2001-2004 was 26 $\mu g/m^3$, while the 98th percentile values

in any given year range from 15 µg/m^3 to 18 µg/m^3. The CWS parameter (98th percentile averaged over 3 consecutive years) for $PM_{2.5}$ was 17 µg/m^3 in 2003 and 16 µg/m^3 in 2004. Therefore, the measured $PM_{2.5}$ concentrations in Brandon are well below the CWS level of 30 µg/m^3, and the Unit 5 stack emissions contribute a relatively minor amount of material to the $PM_{2.5}$ levels in the Brandon area.

The maximum predicted $PM_{2.5}$ concentrations for fugitive dust from coal and ash storage are conservatively estimated at 15 µg/m^3 and 1 µg/m^3, respectively. At the point of maximum predicted concentration, the 98th percentile 24-hour average concentration for fugitive coal dust is only 1.7 µg/m^3, while that for ash is much less than 1 µg/m^3. Although the maximum point of impingement for the Unit 5 stack emissions and fugitive coal/ash emissions do not occur at the same location, the CWS in the area would not be exceeded even if they did coincide and were added to the 98th percentile levels measured at the Assiniboine Community College in Brandon.

For PM_{10} emissions from the Unit 5 combustion stack, the maximum predicted 24-hour incremental concentration is 0.8 µg/m^3. This value is well below the measurement accuracy of a PM_{10} monitor. Therefore, the contributions of particulate matter emissions from the Unit 5 combustion stack do not significantly contribute to the exceedances of the PM_{10} guideline of 50 µg/m^3 that have been recorded at the PM_{10} monitor in Brandon.

The maximum predicted 24-hour average PM_{10} concentrations for fugitive dust emissions are conservatively estimated at 26 µg/m^3 for coal dust and 7 µg/m^3 for ash from the ash storage area. As indicated in Figure 5-4, the location of the maximum POI for fugitive coal dust is approximately 400 metres south of the property line, in an area where there are no residential properties. For the fugitive ash from the ash lagoon, the maximum POI occurs on the shores of the Assiniboine River. Ninety-nine percent (99%) of the time, the maximum contribution of fugitive coal dust to ambient PM_{10} levels anywhere else in the area would be less than 15 µg/m^3. Therefore, fugitive emissions from the Brandon G.S. alone would not be sufficient to cause the high PM_{10} concentrations measured in Brandon. Moreover, as indicated in Table 5-14, the maximum predicted PM_{10} concentrations are negligible at the Riverview Elementary School (i.e., in the closest residential area west of the Brandon G.S. and near the air quality monitoring station at the Assiniboine Community College), as well as at the nearest residence east of the station.

Table 5-14 Maximum Off-Site Air Concentrations (µg/m^3) of Particulate Matter Due to Fugitive Dust Releases

PM Mass Fraction	Coal Storage and Handling		Ash Lagoon	
	Maximum 24-hour	Annual Average	Maximum 24-hour	Annual Average
	Maximum Point of Impingement			
SPM	105	0.5	8	1.3
PM_{10}	26	0.2	7	0.3
$PM_{2.5}$	15	0.1	1	0.1
	Receptor R2 – Riverview Elementary			
SPM	0.09	0.0033	0.15	0.0077
PM_{10}	0.07	0.0025	0.14	0.0074
$PM_{2.5}$	0.009	0.00039	0.014	0.00074
	Receptor R3 – nearest residence east of plant			
SPM	0.52	0.0079	0.29	0.017
PM_{10}	0.40	0.0054	0.28	0.016
$PM_{2.5}$	0.047	0.00083	0.025	0.015

Therefore, while the fugitive coal dust emissions potentially could exceed the PM_{10} health reference level of 25 µg/m^3 on perhaps one day per year, background PM_{10} levels in the area due to other sources are much more significant contributors to observed PM_{10} levels. Therefore, the predicted incremental $PM_{2.5}$ and PM_{10} concentrations from the Brandon G.S. are not discernable from the normal variability in existing air quality.

5.4.2.4 Exposure to Chemicals Other than Combustion Gases

Long-term risks for the COPC are calculated by multiplying the predicted exposure by the carcinogenic slope factor. As discussed above, a cancer risk level of one-in-one hundred thousand (1×10^{-5}) was considered acceptable and at a level where health risks are insignificant. Table 5-15 presents the potential incremental long-term risk levels for the future scenario (OS3).

As indicated in Table 5-15, the cancer risks for long-term exposure to metals, VOCs and PAHs are several orders of magnitude lower than the Health Canada acceptable risk level of one-in-one hundred thousand. These risk levels represent the exposure of people in the community to the upper bound emissions scenario from the operation of Unit 5 at the Brandon G.S. Additionally, these risk levels are well below those associated with exposures to background concentrations of the same chemicals (in the order of 10^{-4} to 10^{-6}). Thus, no measurable increase over background in long-term adverse health effects are predicted and it can be concluded that no measurable adverse health effects would be expected for people in the community from exposure to potential emissions from the current and future operation of Unit 5.

Table 5-15 Total Risk Levels for Predicted Exposures to Chemicals of Concern from the Unit 5 Stack & Fugitive Emissions – OS3[16]

(mg/kg-d)	Receptor 1	Receptor 2		Receptor 3	Receptor 4		Receptor 5	Receptor 6	Receptor 7	Receptor 8	Receptor 9	Max POI	
	Industrial Worker	Resident		School	Resident		School	Industrial Worker	Resident	School	Resident	Resident	
COPC	Adult	Adult	Composite	Adult	Adult	Composite	Adult	Adult	Adult	Adult	Adult	Adult	Composite
Arsenic	$5.20x10^{-9}$	$8.21x10^{-9}$	$8.79x10^{-9}$	$3.17x10^{-9}$	$1.08x10^{-8}$	$1.15x10^{-8}$	$3.49x10^{-9}$	$7.85x10^{-9}$	$3.42x10^{-9}$	$2.57x10^{-9}$	$1.56x10^{-9}$	$1.34x10^{-7}$	$1.43x10^{-7}$
Beryllium	$3.89x10^{-10}$	$6.37x10^{-10}$	$6.81x10^{-10}$	$2.78x10^{-10}$	$7.54x10^{-10}$	$8.06x10^{-10}$	$2.79x10^{-10}$	$6.10x10^{-10}$	$2.51x10^{-10}$	$1.90x10^{-10}$	$1.31x10^{-10}$	$2.19x10^{-8}$	$2.34x10^{-8}$
Cadmium	$2.10x10^{-10}$	$3.19x10^{-10}$	$3.41x10^{-10}$	$1.22x10^{-10}$	$3.88x10^{-10}$	$4.15x10^{-10}$	$1.38x10^{-10}$	$3.14x10^{-10}$	$1.39x10^{-10}$	$1.04x10^{-10}$	$6.07x10^{-11}$	$3.17x10^{-9}$	$3.39x10^{-9}$
Chromium (Total)	$5.48x10^{-8}$	$8.79x10^{-8}$	$9.40x10^{-8}$	$3.70x10^{-8}$	$1.05x10^{-7}$	$1.12x10^{-7}$	$3.84x10^{-8}$	$8.47x10^{-8}$	$3.57x10^{-8}$	$2.70x10^{-8}$	$1.77x10^{-8}$	$2.41x10^{-6}$	$2.58x10^{-6}$
Acetaldehyde	$1.95x10^{-11}$	$2.89x10^{-11}$	$3.09x10^{-11}$	$1.05x10^{-11}$	$3.54x10^{-11}$	$3.78x10^{-11}$	$1.25x10^{-11}$	$2.87x10^{-11}$	$1.33x10^{-11}$	$9.81x10^{-12}$	$5.41x10^{-12}$	$7.79x10^{-11}$	$8.33x10^{-11}$
Benzene	$1.56x10^{-10}$	$2.31x10^{-10}$	$2.47x10^{-10}$	$8.41x10^{-11}$	$2.83x10^{-10}$	$3.03x10^{-10}$	$1.00x10^{-10}$	$2.30x10^{-10}$	$1.06x10^{-10}$	$7.85x10^{-11}$	$4.33x10^{-11}$	$6.23x10^{-10}$	$6.66x10^{-10}$
Benzyl chloride	$5.28x10^{-10}$	$7.84x10^{-10}$	$8.38x10^{-10}$	$2.85x10^{-10}$	$9.60x10^{-10}$	$1.03x10^{-9}$	$3.39x10^{-10}$	$7.79x10^{-10}$	$3.60x10^{-10}$	$2.66x10^{-10}$	$1.47x10^{-10}$	$2.11x10^{-9}$	$2.26x10^{-9}$
di-(2-Ethylhexyl) phthalate	$6.91x10^{-12}$	$3.07x10^{-10}$	$3.54x10^{-10}$	$4.24x10^{-12}$	$3.81x10^{-10}$	$4.40x10^{-10}$	$4.79x10^{-12}$	$6.73x10^{-12}$	$5.23x10^{-12}$	$3.54x10^{-12}$	$2.02x10^{-12}$	$9.63x10^{-10}$	$1.13x10^{-9}$
Bromoform	$6.66x10^{-13}$	$9.89x10^{-13}$	$1.06x10^{-12}$	$3.60x10^{-13}$	$1.21x10^{-12}$	$1.29x10^{-12}$	$4.28x10^{-13}$	$9.82x10^{-13}$	$4.54x10^{-13}$	$3.36x10^{-13}$	$1.85x10^{-13}$	$2.66x10^{-12}$	$2.85x10^{-12}$
Chloroform	$2.11x10^{-11}$	$3.13x10^{-11}$	$3.35x10^{-11}$	$1.14x10^{-11}$	$3.83x10^{-11}$	$4.09x10^{-11}$	$1.35x10^{-11}$	$3.11x10^{-11}$	$1.44x10^{-11}$	$1.06x10^{-11}$	$5.85x10^{-12}$	$8.42x10^{-11}$	$9.01x10^{-11}$
Ethyl Chloride	$5.40x10^{-13}$	$8.02x10^{-13}$	$8.58x10^{-13}$	$2.92x10^{-13}$	$9.82x10^{-13}$	$1.05x10^{-12}$	$3.47x10^{-13}$	$7.97x10^{-13}$	$3.68x10^{-13}$	$2.72x10^{-13}$	$1.50x10^{-13}$	$2.16x10^{-12}$	$2.31x10^{-12}$
Ethylene Dibromide	$1.06x10^{-11}$	$1.58x10^{-11}$	$1.69x10^{-11}$	$5.75x10^{-12}$	$1.94x10^{-11}$	$2.07x10^{-11}$	$6.85x10^{-12}$	$1.57x10^{-11}$	$7.26x10^{-12}$	$5.37x10^{-12}$	$2.96x10^{-12}$	$4.26x10^{-11}$	$4.55x10^{-11}$
Formaldehyde	$4.90x10^{-11}$	$7.27x10^{-11}$	$7.78x10^{-11}$	$2.65x10^{-11}$	$8.90x10^{-11}$	$9.52x10^{-11}$	$3.15x10^{-11}$	$7.22x10^{-11}$	$3.34x10^{-11}$	$2.47x10^{-11}$	$1.36x10^{-11}$	$1.96x10^{-10}$	$2.09x10^{-10}$
Isophorone	$2.44x10^{-12}$	$3.66x10^{-12}$	$3.91x10^{-12}$	$1.32x10^{-12}$	$4.48x10^{-12}$	$4.80x10^{-12}$	$1.57x10^{-12}$	$3.61x10^{-12}$	$1.67x10^{-12}$	$1.23x10^{-12}$	$6.79x10^{-13}$	$1.00x10^{-11}$	$1.07x10^{-11}$
Methyl Hydrazine	$8.30x10^{-10}$	$1.48x10^{-8}$	$1.80x10^{-8}$	$4.49x10^{-10}$	$2.12x10^{-8}$	$2.57x10^{-8}$	$5.34x10^{-10}$	$1.22x10^{-9}$	$5.66x10^{-10}$	$4.18x10^{-10}$	$2.31x10^{-10}$	$1.21x10^{-7}$	$1.48x10^{-7}$
Dichloromethane	$2.12x10^{-12}$	$3.15x10^{-12}$	$3.37x10^{-12}$	$1.15x10^{-12}$	$3.86x10^{-12}$	$4.13x10^{-12}$	$1.36x10^{-12}$	$3.13x10^{-12}$	$1.45x10^{-12}$	$1.07x10^{-12}$	$5.90x10^{-13}$	$8.49x10^{-12}$	$9.08x10^{-12}$
Benzo(a)pyrene	$3.46x10^{-12}$	$1.57x10^{-11}$	$1.88x10^{-11}$	$3.95x10^{-12}$	$8.11x10^{-11}$	$9.84x10^{-11}$	$4.78x10^{-12}$	$2.99x10^{-12}$	$5.26x10^{-12}$	$3.03x10^{-12}$	$1.39x10^{-12}$	$6.02x10^{-10}$	$7.39x10^{-10}$
Benzo(b)fluoranthene	$2.73x10^{-13}$	$1.30x10^{-12}$	$1.50x10^{-12}$	$2.32x10^{-13}$	$6.36x10^{-12}$	$7.49x10^{-12}$	$2.79x10^{-13}$	$3.15x10^{-13}$	$3.02x10^{-13}$	$1.89x10^{-13}$	$9.32x10^{-14}$	$4.42x10^{-11}$	$5.25x10^{-11}$
Chrysene	$9.32x10^{-15}$	$4.60x10^{-14}$	$5.46x10^{-14}$	$1.00x10^{-14}$	$2.38x10^{-13}$	$2.87x10^{-13}$	$1.21x10^{-14}$	$8.67x10^{-15}$	$1.33x10^{-14}$	$7.77x10^{-15}$	$3.62x10^{-15}$	$1.75x10^{-12}$	$2.13x10^{-12}$
Indeno(1,2,3-cd)pyrene	$1.85x10^{-13}$	$6.75x10^{-13}$	$8.03x10^{-13}$	$2.11x10^{-13}$	$3.34x10^{-12}$	$4.06x10^{-12}$	$2.56x10^{-13}$	$1.59x10^{-13}$	$2.82x10^{-13}$	$1.62x10^{-13}$	$7.45x10^{-14}$	$2.45x10^{-11}$	$3.02x10^{-11}$
TCDD, 2,3,7,8 (Dioxins)	$5.37x10^{-10}$	$2.09x10^{-9}$	$2.38x10^{-9}$	$4.37x10^{-10}$	$9.26x10^{-9}$	$1.08x10^{-8}$	$5.00x10^{-10}$	$6.88x10^{-10}$	$5.19x10^{-10}$	$3.39x10^{-10}$	$1.83x10^{-10}$	$7.11x10^{-8}$	$8.27x10^{-8}$
benz(a)anthracene	$2.30x10^{-13}$	$1.13x10^{-12}$	$1.35x10^{-12}$	$2.54x10^{-13}$	$5.86x10^{-12}$	$7.10x10^{-12}$	$3.08x10^{-13}$	$2.06x10^{-13}$	$3.39x10^{-13}$	$1.96x10^{-13}$	$9.10x10^{-14}$	$4.35x10^{-11}$	$5.33x10^{-11}$
benzo(k)fluoranthene	$4.55x10^{-14}$	$1.99x10^{-13}$	$2.37x10^{-13}$	$5.21x10^{-14}$	$1.02x10^{-12}$	$1.24x10^{-12}$	$6.30x10^{-14}$	$3.91x10^{-14}$	$6.94x10^{-14}$	$4.00x10^{-14}$	$1.84x10^{-14}$	$7.56x10^{-12}$	$9.30x10^{-12}$
dibenzo(a,h)anthracene	$1.95x10^{-13}$	$7.48x10^{-13}$	$8.89x10^{-13}$	$2.24x10^{-13}$	$3.73x10^{-12}$	$4.53x10^{-12}$	$2.71x10^{-13}$	$1.68x10^{-13}$	$2.98x10^{-13}$	$1.72x10^{-13}$	$7.89x10^{-14}$	$2.74x10^{-11}$	$3.38x10^{-11}$
Quinoline	$9.08x10^{-13}$	$2.02x10^{-11}$	$2.40x10^{-11}$	$1.04x10^{-12}$	$1.18x10^{-10}$	$1.40x10^{-10}$	$1.25x10^{-12}$	$7.83x10^{-13}$	$1.38x10^{-12}$	$7.95x10^{-13}$	$3.66x10^{-13}$	$1.04x10^{-9}$	$1.24x10^{-9}$

[16] Refer to Figures 5-4 and 5-30 for points of maximum impingement.

5.4.2.5 Exposure to Radionuclides

Coal and coal ash contain trace quantities of naturally occurring radionuclides such as uranium and thorium, and the corresponding members of their respective decay series (a total of 14 radionuclides in the U-238 series and 10 in the Th-232 series). During combustion, some of these radionuclides are released into the atmosphere with flue gases, and the remainder are retained in fly and bottom ash. Also, some of the radioactivity in coal ash can be re-suspended into the air by wind and mechanical manipulation of stockpiles.

Atmospheric dispersion modelling was used to estimate the annual average airborne concentrations of uranium and thorium at selected locations around the facility that are attributable to releases from the Brandon G.S. Unit 5 operations (see Appendix N). The highest incremental annual average concentrations of uranium and thorium in air (from both stack and fugitive emission) for the future scenario (OS3) are predicted to be 5.1×10^{-5} μg/m^3 and 5.4×10^{-6} μg/m^3, respectively.

Natural background uranium concentrations in air have been measured at only a few locations in Canada and in the United States. Tracy and Prantl (1985) reported the ambient concentration of uranium in air in southern Ontario at 1×10^{-4} μg/m^3, and Ahier and Tracy (1993) reported the mean concentration in Oshawa, Ontario at approximately 6×10^{-4} μg/m^3, ranging from 2×10^{-4} to 12×10^{-4} μg/m^3. Airborne concentrations of uranium were reported at selected centres in the United States by the U.S. National Council on Radiation Protection and Measurements (NCRP 1975). Based on these reported levels, typical natural background concentrations of thorium in air can range from 1.3×10^{-4} to 4.0×10^{-4} μg/m^3.

The incremental airborne concentrations of uranium and thorium that are attributable to releases from the coal-fired operations of the Brandon G.S. are expected to be a small fraction of the natural background concentrations of uranium and thorium in air. In addition, the incremental concentrations are also a small fraction of the variability in the natural background concentrations. Therefore, the effects from inhalation and deposition to soil and vegetation of releases from naturally occurring radioactivity in the coal and coal ash are expected to be insignificant, and indistinguishable from the effects of naturally occurring uranium and thorium in the air.

5.4.3 ECOLOGICAL (VEGETATION, ANIMALS, LIVESTOCK) ASSESSMENT

A screening level ecological risk assessment was performed for representative ecological receptors (e.g., vegetation, as well as wild and domestic animals) to cover a range of possible exposure scenarios following the guidance set out by the CCME.

The first step of the assessment was a screening process that involved the comparison of the estimated soil concentrations at the maximum point of impingement (areas of maximum chemical concentration) to available Canadian Soil Quality Guidelines and vegetation Toxicity Reference Values (TRVs). The CCME parkland category was chosen to represent the most appropriate soil criteria. The ecological component of the criteria is protective of both plant and animal species. Soil concentrations below the CCME guideline or vegetation TRVs were not considered further. As a result of the screening process, only dioxin was carried through the ecological assessment since dioxins are generally biomagnified up the food chain.

In the receptor characterization phase of the assessment, ecological receptors were identified. Figure 5-31 indicates the various receptors that were selected for this assessment. These receptors were chosen to represent a wide range of exposure.

Terrestrial plants and crops comprise one of the most potentially exposed populations since these receptors reside in the soil and are therefore continuously exposed to contaminated soil. Because these receptors are not mobile or have limited mobility, they would be exposed to the contamination in place over a lifetime. The terrestrial vegetation receptors chosen for this assessment comprise a generic terrestrial plant species that represents grasses, shrubs and trees and crops. The selection of this generic receptor is a typical assumption in ecological risk assessments.

Terrestrial invertebrates or soil dwelling organisms also comprise a potentially highly exposed population since these receptors reside in the soil and are therefore continually exposed to contaminated soil. These soil dwelling organisms will act as a surrogate for effects on all soil dwelling organisms due to the fact that the most comprehensive toxicity data is available for the earthworm.

The vegetation that will be at the receptor location may provide a food source for terrestrial receptors. Small mammals such as mice will most likely inhabit the study area. In general, these small mammals are potentially exposed by consuming vegetation as well as through direct contact with the soil. These receptors generally have a limited home range in which they reside; however, due to their mobility within this range these receptors may experience a wide variation in their exposure. Larger, more mobile animals such as rabbits and foxes may also inhabit the ecological area surrounding the Brandon G.S. It is expected that for many of these receptors exposure to COPC at the site will be limited as these species are highly mobile and forage for food in many places. Therefore, for this assessment, the white-footed mouse was used as a representative species. In addition, since there are farms in the study area, cows and horses were used as representative species for the farm as they are potentially exposed by grazing and ingestion of soil. Pigs and chickens were not considered as they consume food that is not grown exclusively in the study area. Furthermore, the ecological risk assessment uses surrogate animals that have similar diets. Even though the assessment does not cover all animals, inferences can be drawn from the animals considered in the assessment. For example, if wild birds are not adversely affected by the emissions from Unit 5, then chickens will also not be adversely affected. Similarly, if cows are not adversely affected, then pigs surely will not be adversely affected.

Birds are also expected to be in the study area, thus both a robin, which consumes earthworms and vegetation, and a predatory owl were considered in the assessment. These two species were considered to represent a range of exposures experienced by terrestrial birds which encompasses the maximum potential exposure.

The exposure risk assessment considered the exposure of the various receptors to dioxins because dioxins are generally biomagnified up through the food chain. For the assessment of potential effects on terrestrial plants and soil dwelling organisms, the TRV for dioxin in soil was compared directly to predicted soil concentrations, for all other terrestrial animals, exposure values were calculated. The dioxin emission used in this assessment was for the upper bound emission scenario, namely OS3.

In considering the appropriate concentrations to use in the risk assessment, Receptor Locations 9, 10 and 11 were evaluated. Receptor Location 9 is near agricultural land for a research station, northwest of

Unit 5, Receptor Location 10 is the Brandon Hills which are the largest tract of forested land near the site and is surrounded by different habitats such as prairie, parkland, and boreal forest and Receptor Location 11 is the location of a marsh area (Douglas Marsh) which has a large wetland area that is habitat to a large number of aquatic birds. Therefore, ducks were considered in this area. There was inadequate information available to calculate the incremental concentrations of dioxins in the sediments in the Douglas Marsh. Therefore, only the water pathway were considered. It should be noted that even though the sediment pathway of exposure was not considered in the assessment, the emissions of dioxins from the facility were so low that it is unlikely that they can be discerned to be different from background.

The maximum predicted incremental dioxin soil concentrations for the maximum theoretical Unit 5 operating condition (i.e., with Unit 5 operating at 100 % C.F.) occurred at Receptor Location 11 (9.5×10^{-10} mg/kg). This is an extremely low concentration. This concentration results in exposure values for the most exposed receptor (mouse) of 1.7×10^{-11} mg/kg-d. This results in a screening index value of 1.4×10^{-5}, which is well below 0.2, which is considered by the CCME to represent insignificant exposure. Thus indicating that it is unlikely that any ecological receptors will be adversely affected by the emissions from Unit 5 of the Brandon G.S.

5.4.4 CERTAINTY OF RESULTS

An evaluation of the uncertainties in various measurements and methods used in the current assessment indicated that the risks have been over-estimated as a result of the assumptions made about exposure (which were generally cautious). The results of this uncertainty analysis support the overall conclusion that no measurable adverse effects would occur in the human or ecological community surrounding the Brandon G.S.

5.4.5 CONCLUSION

In summary, the results of the human health and ecological risk analysis determined that there will be no incremental, measurable adverse effects on the humans or the environment from the operation of the Unit 5 at the Brandon G.S.

5.5 SUMMARY OF RESIDUAL EFFECTS

Table 5-16 summarizes residual effects of operation of Unit 5, and describes each effect in terms of the magnitude, spatial extent of area affected, duration, frequency, and potential for a measurable effect to the air and noise environment.

Figure 5-29 Conceptual Model and Potential Pathways of Exposure for Human Receptors

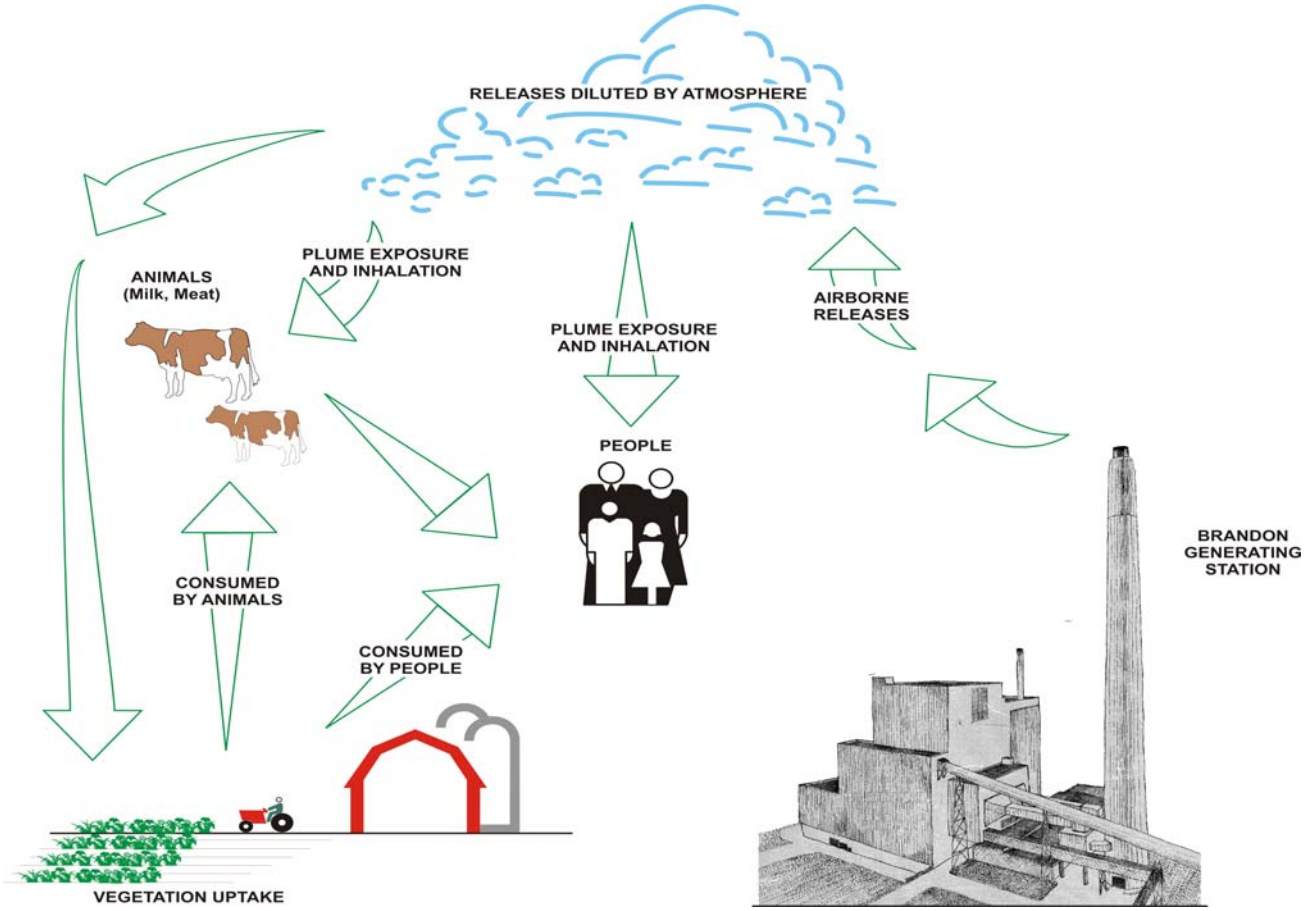


Figure 5-30 Receptor Locations

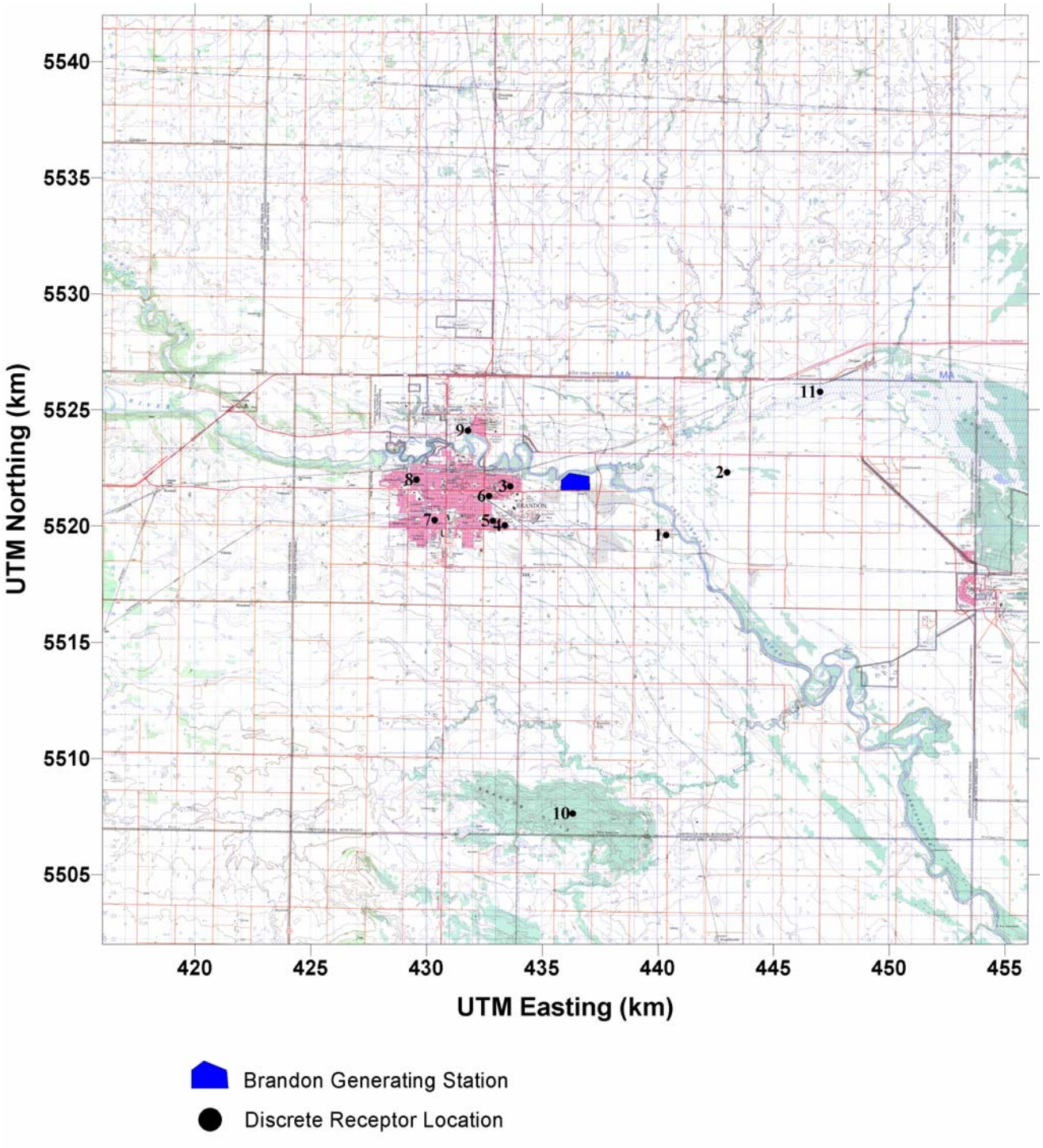


Figure 5-31 Ecological Receptors Used in the Assessment of Risks From the Coal-Fired Operation of the Brandon G.S.

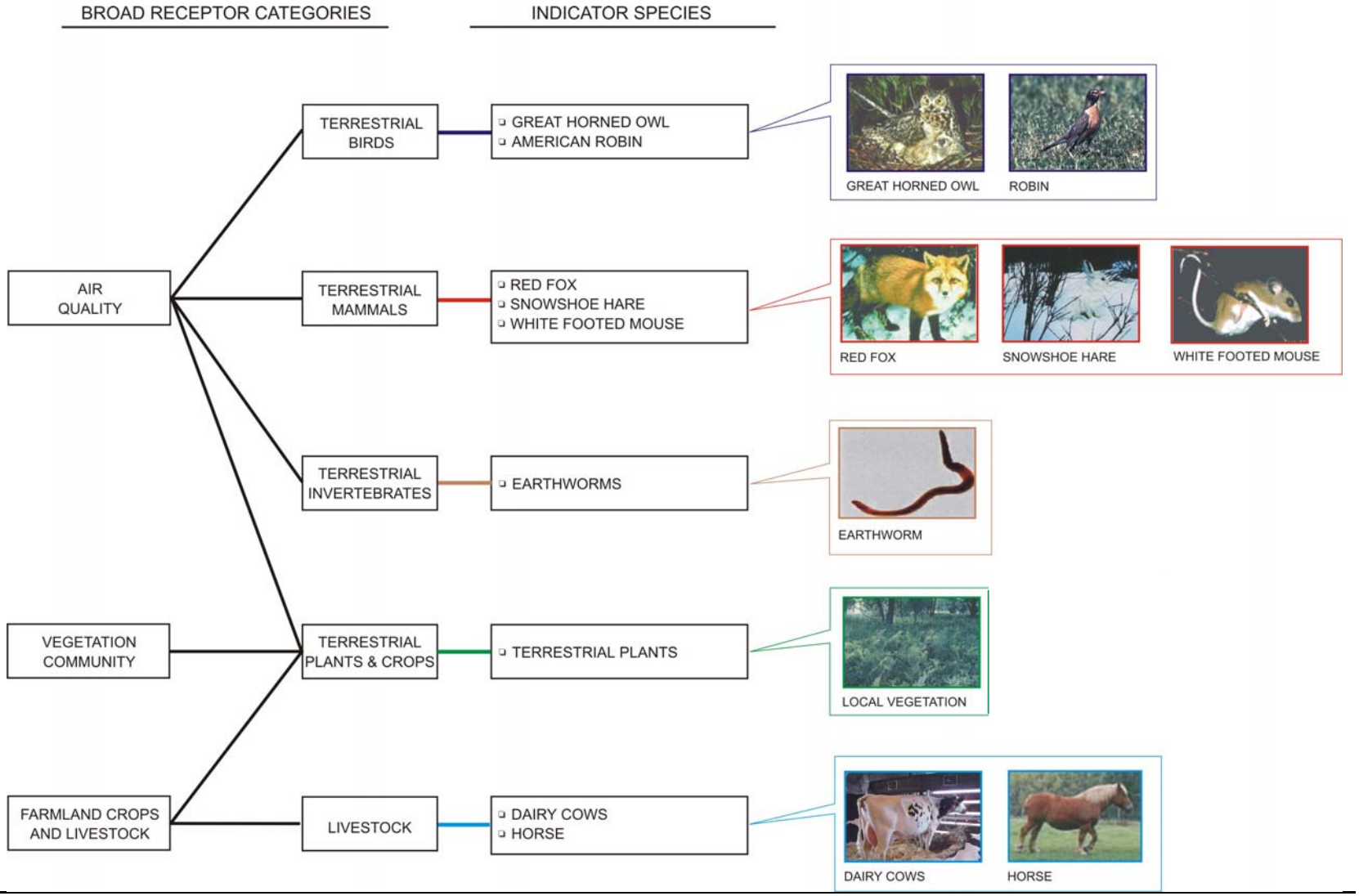


Table 5-16 Residual Effects of the Operation of the Brandon G.S. on the Air and Noise Environment.

Source of Effect	Description of Effect	Mitigation Measures	Residual Effects
Release of air emissions to the environment	Air emissions from the operation of Unit 5 result in air emission concentrations in the ambient air downwind of the Brandon G.S.	Emissions from the Unit 5 stack are mitigated through the use of the burner management system and operation and maintenance activities to maximize the efficiency of the Unit 5 boiler, and minimize the emission of CO and NO_x. Manitoba Hydro has consistently used a low sulphur coal in its operations in order to minimize SO_2 emissions. A high-efficiency electrostatic precipitator is used to minimize emission of particulate matter, as well as of associated organic and inorganic compounds. Manitoba Hydro has voluntarily committed to the early adoption of a proposed cap on total mercury emissions before the implementation date for a Canada-Wide Standard. Manitoba Hydro has conducted a detailed review of the coal quality characteristics of available coal suppliers with a view to minimizing, to the extent possible, emissions of particulate matter, SO_2 and trace heavy metals in future operations.	Effect is largely restricted to air dispersion area (30 km x 30 km). The air quality assessment concluded that predicted ambient air emission concentrations from the Brandon G.S. (Units 5, 6&7) meet all of the Manitoba and Federal Maximum Acceptable ambient air quality objectives for CO, NO_2, and SO_2 even when the Brandon G.S. is operated at maximum rate and combined with background ambient concentrations from other sources in the area. Canada-Wide Standards for $PM_{2.5}$ would also not be exceeded under any operational scenarios. Although Manitoba's PM_{10} guideline value is exceeded in Brandon, from all emission sources, on a regular basis, the contribution of both stack and fugitive dust emissions from the Brandon G.S. to those

Source of Effect	Description of Effect	Mitigation Measures	Residual Effects
		Manitoba Hydro monitors and records concentrations of pollutants emitted to the atmosphere from the Unit 5 stack through a stack sampling program. These data are reported to Manitoba Conservation. In order to reduce fugitive dust emissions from coal storage and handling operations, Manitoba Hydro: 1) unloads coal railcars in an enclosed facility (with a dust collection system) to underground hoppers, 2) may wet down the long-term coal storage pile which limits disturbance of the pile to periods when winds will not cause high levels of fugitive dust emission.	exceedances at the monitoring site and in residential areas around the facility is negligible. Predicted levels of PAH, VOC and trace organic and inorganic compounds are insignificant when compared with ambient levels measured in downtown Winnipeg, or as defined by air quality objectives in other provinces. The human health and ecological risk assessment determined that there would be no measurable, adverse effects on the human, wildlife, livestock, vegetation and soil communities from the continued operation of Unit 5.
Noise emissions	None	None	None

CHAPTER 6

PHYSICAL ENVIRONMENT

6.0 PHYSICAL ENVIRONMENT

This chapter contains an examination of the existing physical environmental conditions within the property boundaries of the Brandon G.S., including the wooded area adjacent to the Assiniboine River and north of the ash lagoon. The current conditions related to terrestrial biology, soils and geology and hydrogeology and the effects on these components with continued operation of Brandon G.S. Unit 5 are assessed. The assessment of these parameters was based on a review of regional information for the Aspen Parkland Ecoregion (Smith et al., 1998).

6.1 EXISTING ENVIRONMENT

The Brandon G.S. property is located on the outskirts of the City of Brandon, in the Regional Municipality (R.M.) of Cornwallis. The Brandon G.S. site is located at the northeast corner of the intersection of Victoria Ave East and 33rd Street. The generating station is bordered by lands zoned primarily as industrial to the south and west, and rural to the north and east. The study area assessed for the Physical Environment component of the EIS encompasses only the land within the Brandon G.S. property boundaries.

The Brandon G.S. consists of the original generating station, constructed in 1955, that houses Units 1 through 5, while units 6&7 are located in a separate building to the south (Figure 6-1). Units 1 through 4 have been retired. The Brandon G.S. and the coal stockpile are located on the southwestern portion of the property. The ash lagoon is located northeast of the generating station. There is currently only one ash lagoon cell in use (east cell), the second lagoon cell (west) has been closed. There are plans to develop additional lagoon cells on land adjacent to the existing lagoon cell.

Appendix O (Terrestrial Species Summary) contains four tables that describe terrestrial biological features based on species population distribution within the Aspen Parkland Ecoregion, Mammal species (O-1), Bird Species (O-2), Plant Species (O-3) and Species at Risk (O-4). The Brandon G.S. is located within this ecoregion; however, it is highly unlikely that the Species at Risk would be contained within the study area (Appendix O; Bezener and De Smet, 2000; Environment Canada, 2006; Kurta, 2001; Manitoba Conservation, 2006). Aquatic species are found in a separate appendix (Appendix F) as part of the Aquatic Environment study.

6.1.1 TERRESTRIAL BIOLOGY

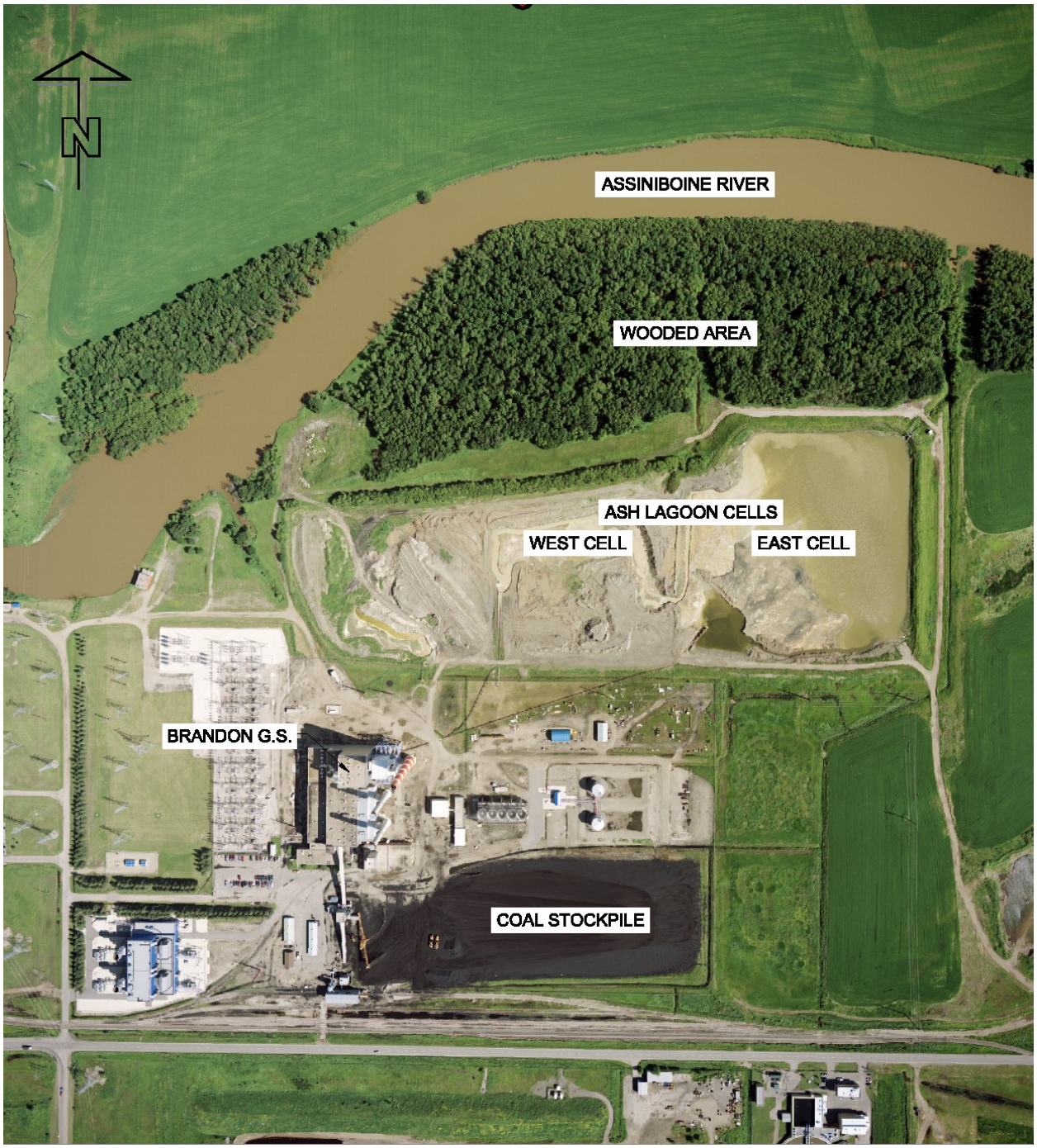
6.1.1.1 Wildlife and Wildlife Habitat

There is little natural habitat not affected by human presence in close proximity to the Brandon G.S. The site itself has been highly disturbed by on-going activities. The only area of potential wildlife habitat is the riparian zone along the Assiniboine River and a small wooded area north of the ash lagoon.

As noted in Manitoba Hydro's 1992 EIA (Senes, 1992) the wooded area, although not exceptional, is worthy of protection because of its size and location along the Assiniboine River. In this regard, Manitoba Hydro has no plans to develop in this area and will endeavour to maintain the area in its natural state.

The potential exists for a mixture of wildlife species typical of this Ecoregion to be present in the study area. This includes the ferruginous hawk, olive-packed pocket mouse, northern grasshopper mouse and hognose snake. The wooded area north of the ash lagoon is habitat for the white-tailed deer, red squirrel, scarlet tanager and many warblers (Table O-1).

Figure 6-1 Brandon G.S. Site



As the majority of the study area has already been disturbed, the remaining habitat of most significance to wildlife on-site is the wooded area north of the ash lagoon, which is habitat for white-tailed deer. The Assiniboine River is also important to waterfowl and shorebirds; there are many bird species that use the river as part of their distribution and/or breeding range. Table O-2 lists birds that have distribution and habitat ranges that fall into the Brandon G.S. study area. This does not mean that they are present, but that they could potentially be present. All bird species that have been marked by an asterisk in Table O-2 are protected under the federal Migratory Birds Convention Act (MBCA), which applies to both federal and provincial lands.

The federal Species at Risk Act (SARA) and the Manitoba Endangered Species Act (MESA) are in place to preserve and protect wildlife species designated as being at risk. Constitutional authority for wildlife is shared between the federal and provincial governments. Since SARA is a federal act, it is limited to federal land, except for aquatic species and migratory birds that are protected wherever they are found. MESA protects provincially listed species on provincial and private land. It is highly unlikely that these species are contained within the study site (Appendix O, Bezener and De Smet, 2000; Environment Canada, 2006; Kurta, 2001; Manitoba Conservation, 2006).

Table O-4 lists species protected under MBCA, SARA and/or MESA whose habitat range overlaps with the Brandon G.S. site. The list includes the bird species ferruginous hawk (threatened), peregrine falcon (threatened), Baird's sparrow (endangered), Sprague's pipit (threatened), yellow rail (special concern) and the (prairie) loggerhead shrike (threatened); the insect species monarch butterfly (special concern); the station species Dakota skipper (threatened), Ottoe skipper (endangered), small white lady's slipper (endangered) and the amphibian species the northern leopard frog (special concern). Aquatic habitat and biota have been previously discussed in Section 4.1.3 and are summarized in Appendix F.

6.1.1.2 Vegetation

Typical vegetation within the Aspen Parkland Ecoregion is comprised of grassland with hazel, common and horizontal juniper, white spruce, scrub trembling aspen and sometimes scrub bur oak. Table O-3 lists only the dominant and expected plant species within the vicinity of the Brandon G.S. site.

The Brandon G.S. site itself has been highly disturbed by on-going activities. The remaining vegetation communities are located within the wooded area north of the ash lagoon. The small white lady's slipper is the only endangered plant species listed as having the possibility for being present within the study area as there are appropriate habitat conditions present.

6.1.2 SOILS

The Brandon G.S. study area is underlain by up to 70 m of overburden materials consisting of clay, silt, sand and gravel. The bedrock consists of carbonaceous and calcareous shales of the Vermillion River Formation, underlain by the shales of the Favel and Ashville Formations. Due to the presence of underlying shales within the Brandon area, potable supplies of groundwater cannot be developed within the bedrock and the base of the overburden sequence is considered the base of exploration for groundwater wells.

The area is located on the part of the Assiniboine River Plain physiographic region known as the Upper Assiniboine Delta. This area is at the apex of an extensive deltaic deposit formed at the time when the Assiniboine River was discharging to Glacial Lake Agassiz. As is typical of deltaic deposits, the area has been subject to numerous erosion and deposition events that result in a complex series of paleo-channel deposits. As such, the thickness and distribution of the geologic materials varies substantially. In general, the overburden sequence consists of 6 to 15 metres of clay underlain by a complex sequence of interlayered sands, gravels, clays and glacial tills to the bedrock surface.

The upper 1.5 metres of the overburden profile has been mapped in detail and has been subdivided into two general soil associations consisting of the Marringhurst Sandy Loams in the uplands and the Assiniboine Complex in the river valley lowlands.

The Marringhurst Sandy Loam soils are developed on gravel and coarse sand outwash deposits of shale, limestone and granitic origin. The surface soil texture varies from a loamy coarse sand to sandy loam, with the coarser textures predominating. The topography is level to gently undulating. The area is well drained due to the rapid infiltration rate of the coarse textured soils.

The Assiniboine Complex soils have been developed upon the alluvial deposits along the broad valley floor of the Assiniboine River. The texture of the soil varies significantly from a loamy fine sand to clay depending on the underlying parent material. The topography is level. Drainage varies from well drained in the coarse textured areas to poorly drained in the fine textured areas.

On the generating station site, the northern and northeastern parts of the site are underlain by imperfectly drained soils ranging from loamy to clayey types derived from the underlying alluvium. Permeabilities are moderately slow to slow. Within the main generating station area, the soils are primarily coarser loams derived from the underlying lacustrine deposits. Permeabilities are higher than the adjoining alluvial derived soils, however the water table is typically high in spring and early summer and drainage can be poor.

6.1.3 HYDROLOGY

6.1.3.1 Surface Water

The Assiniboine River is the primary surface watercourse in the Brandon G.S. area and is located on the north side of the Brandon G.S site. The west ash lagoon cell is located approximately 80 m southeast of the closest point on the Assiniboine River. The east ash lagoon is the only functioning lagoon on-site and is located approximately 240 m from the closest point on the Assiniboine River. Section 4.1.1 discusses the Assiniboine River hydrology in greater detail.

6.1.3.2 Groundwater

Groundwater can be found in significant quantities in unconfined surficial aquifers and confined aquifers at depth in the overburden sequence. Relative to the Brandon G.S. site, the aquifer of primary concern is the upper unconfined aquifer. This aquifer is directly exposed at the surface and the regional groundwater flow direction is from recharge in the uplands (Marringhurst Sandy Loams) and lateral flow through the Assiniboine Complex to the river. The Assiniboine Complex is located within the river valley and the

uplands border it to the north and south. Relative to this site, the uplands are to the south. A downward gradient is possible locally, particularly to the west of the Brandon G.S. where there is extensive pumping of groundwater to the southwest by other industrial users.

The water table in the unconfined surficial aquifer is located near surface, and as such is locally influenced by the surface water drainage ditches on and around the site. In the area of the ash lagoon, the indicated groundwater flow direction based on the monitoring data is to the northwest towards the river and to the southeast from a groundwater flow divide located between the ash lagoon and the north side of the coal storage area (UMA, 1995).

As required by the Environment Act Licence for the Brandon G.S. and a subsequent letter issued by the Director of Environmental Management, a groundwater monitoring program (Appendix P) was implemented in 1992 and revised in 1997. The monitoring program consisted of thirteen operational observation wells (Figure 6-2). The purpose of the program is to monitor and collect data to determine the quality of the groundwater and water table elevations. Concentrations of most parameters in the majority of samples were within the recommended range indicated by Manitoba and Summary Guidelines for Canadian Drinking Water Quality (Health Canada, 2002) and the guidelines for Freshwater Aquatic Life (CCME, March 2006).

6.2 ENVIRONMENTAL EFFECTS

The assessment of the environmental effects to the physical environment focused on the continued operation of Unit 5, in particular the operation of the ash lagoon and the coal stockpile. The assessment considered the effects on wildlife, wildlife habitat, vegetation, soil and groundwater within the study area.

6.2.1 TERRESTRIAL BIOLOGY

It is not expected that continued operation of Unit 5 will result in any new or increased adverse effects on the local wildlife, wildlife habitat or vegetation in the study area. The construction and operation of the Brandon G.S. Unit 5 have already affected the local vegetation and wildlife habitat and are not anticipated to change. In the future, areas previously affected by the west cell of the ash lagoon will be rehabilitated as part of the planned ash lagoon decommissioning activities. The rehabilitated area will provide habitat opportunities.

This review indicates the effects of continued operation of Unit 5 will not significantly change the terrestrial environment at the Brandon G.S.

6.2.1.1 Wildlife and Wildlife Habitat

It is not expected that the continued operation of Unit 5 will result in any new adverse effects on the local wildlife or wildlife habitat.

6.2.1.2 Vegetation

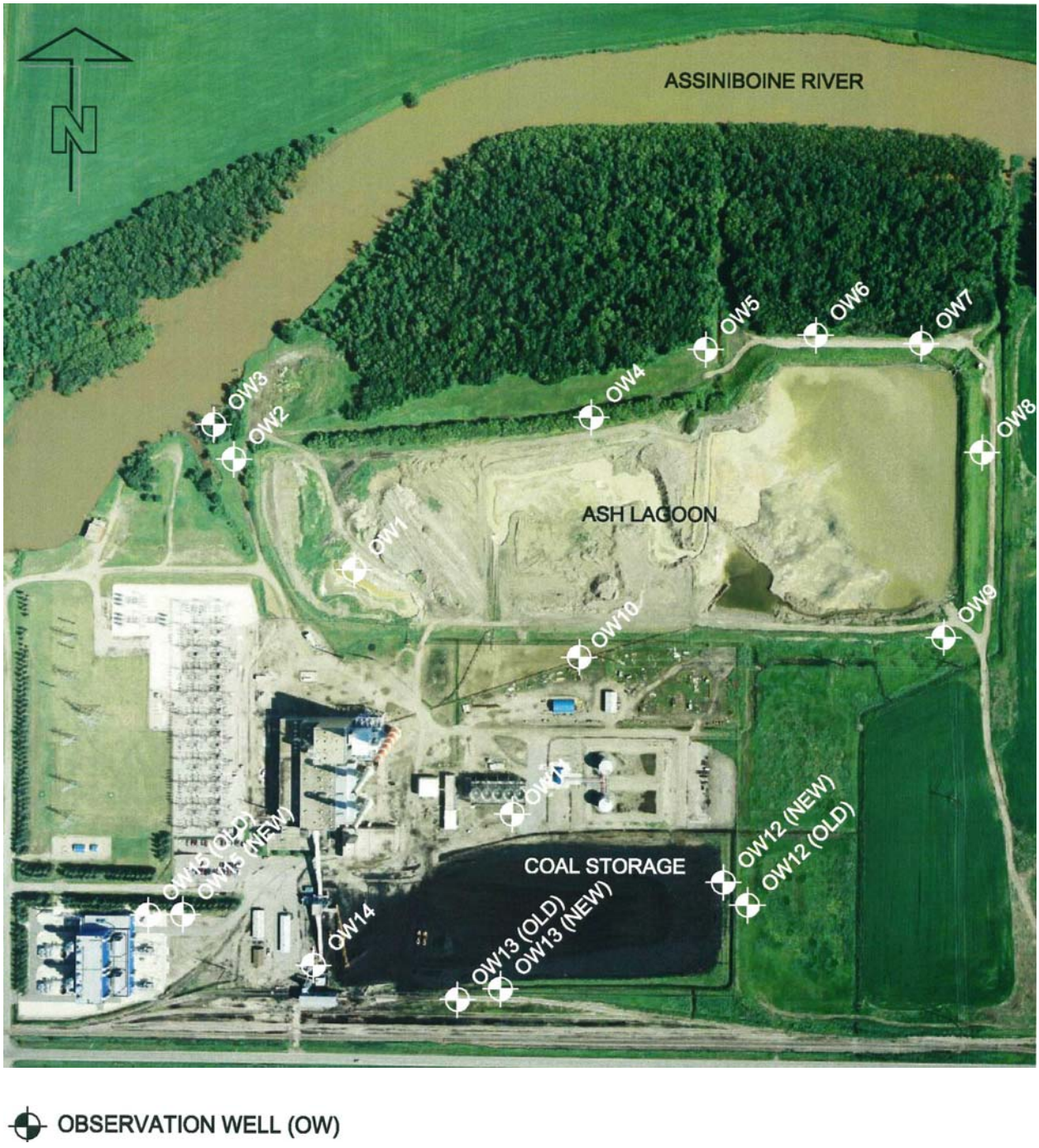
Results from the air modelling (Chapter 6) and The Human Health and Ecological Risk Assessment (Appendix K) indicate that there will be no significant effects on the vegetation communities at the Brandon G.S.

The continued operation of Unit 5 will not require the removal of any additional vegetation beyond that which has already been disturbed to construct the station.

6.2.2 SOILS

Potential effects to the soils at the Brandon G.S. as a result of air emissions are discussed in Chapter 5. The effect to soils as a result of the continued operation of the ash lagoon and coal stockpile is negligible.

Figure 6-2 Monitoring Well Locations for the Groundwater Monitoring Program



6.2.3 HYDROLOGY

6.2.3.1 Groundwater

Data collected from the groundwater monitoring program indicates that concentrations of most parameters in the majority of samples were within the recommended range of the above listed guidelines. (Table 6-1). The data is provided in the Brandon Generating Station Groundwater Monitoring Program 1993-2004 Summary of Monitoring Results report (Appendix P – Brandon Groundwater Monitoring Report).

The review of the water quality data for samples collected around the ash lagoon area indicate that, in general, the results have not significantly changed over the monitoring period. The exception is the arsenic concentrations recorded from wells along the north side of the lagoon. Since September of 2003, arsenic concentrations have increased significantly relative to the historical concentrations. This increase in arsenic concentration coincides with an increase in groundwater levels associated with dredging activities conducted in 2003 and the subsequent operation of the lagoon at a higher operating water level. The chemical response appears to be limited to arsenic and no corresponding trend is evident in the other lagoon effluent indicator parameters.

Although arsenic concentrations in the groundwater exceed the National Guideline for Freshwater Aquatic Life (CCME, 2006) adverse effects due to groundwater seepage to the river are not expected. The assessment of the potential effect of direct discharge of the ash lagoon effluent to the river found that no adverse effect is occurring (Appendix I (Effluent Toxicity Report)). Due to the low permeability of the soil materials in this area, the groundwater flow rate to the river is low, and any additional contributions of groundwater to the river would be negligible relative to the direct discharge of effluent to the river.

The results from the groundwater monitoring program indicate that the continued operation of the coal stockpile is not expected to result in any significant effects to local groundwater quality. Therefore, the groundwater resource has not been adversely affected.

6.2.3.1.2 Groundwater Levels

Groundwater is not used in any of the Brandon G.S. operations. Based on the ongoing groundwater monitoring program results, groundwater levels in the 13 wells reflect their common hydrological influences. Groundwater levels have fluctuated over the period of record, but no long term trend in the results is evident. Most of the groundwater monitoring wells respond to seasonal changes in infiltration rates.

In 2003, the groundwater level at monitoring well OW6, on the north side of the ash lagoon, was at its highest recorded level. This coincides with a change in operating procedure to improve the operational performance of the ash lagoon and to facilitate maintenance activities (Appendix P).

Continued operation of Unit 5 is not expected to result in any effects to local water tables.

Table 6-1 Guidelines for Groundwater Quality

Parameter	Manitoba Tier II and III Guidelines*	National Guideline**
A. Standard Constituents		
Total Dissolved Solids	500,000 µg/L (3)	500,000 µg/L (10)
Conductivity	No Numerical Guideline	No Numerical Guideline
pH	6.5 – 8.5 pH units (3)	6.5 – 8.5(10)
Total Hardness	No Numerical Guideline	No Numerical Guideline
Total Alkalinity	No Numerical Guideline	No Numerical Guideline
Carbonates CO_3	No Numerical Guideline	No Numerical Guideline
Bicarbonates HCO_3	No Numerical Guideline	No Numerical Guideline
Total Chlorides	250,000 µg/L (3)	250,000 µg/L (10)
Nitrates	45,000 µg/L (1)	45,000 µg/L (8)
Sulphates	500,000 µg/L (3)	500,000 µg/L (10)
B. Trace Elements		
Arsenic	25 µg/L(2)/150 µg/L(6)	25 µg/L (9)
Barium	1,000 µg/L (1)	1,000 µg/L (8)
Boron	5,000 µg/L (2)	5,000 µg/L (9)
Cadmium	5 µg/L (1)/3.8 µg/L(6)	5 µg/L (8)
Calcium	1,000,000 µg/L (5)	No Numerical Guideline
Chromium	50 µg/L (1)/133 µg/L(6)(7)	50 µg/L (8)
Copper	1,000 µg/L (3)/17µg/L(6)	1,000 µg/L (10)
Iron	300 µg/L (3)	300 µg/L (10)
Lead	10 µg/L (1)/5.4 µg/L(6)	10 µg/L (8)
Magnesium	No Numerical Guideline	No Numerical Guideline
Manganese	50 µg/L (3)	50 µg/L (10)
Nickel	200 µg/L (4)/95 µg/L(6)	25 – 150 µg/L(11)
Potassium	No Numerical Guideline	No Numerical Guideline
Selenium	10 µg/L(1)/1 µg/L(6)	10 µg/L (8)
Sodium	200,000 µg/L (3)	200,000 µg/L (10)
Zinc	5,000 µg/L (3)/217 µg/L(6)	5,000 µg/L (10)

* Manitoba Tier II and III Guidelines as in:
Manitoba Water Quality Standards, Objectives and Guidelines, 2002
(1) Manitoba Guidelines - Drinking Water – Maximum Acceptable Concentration
(2) Manitoba Guidelines - Drinking Water – Interim Maximum Acceptable Concentration
(3) Manitoba Guidelines - Drinking Water – Aesthetic
(4) Manitoba Guidelines – Groundwater Irrigation
(5) Manitoba Guidelines – Groundwater Livestock Watering
(6) Manitoba Guidelines – Freshwater Aquatic Life (Chronic)
(7) Chromium III

** National Guidelines as in:
Guidelines for Canadian Drinking Water Quality, Health Canada, March 2006.
(8) National Guidelines – Drinking Water – Maximum Acceptable Concentration
(9) National Guidelines – Drinking Water - Interim Maximum Acceptable Concentration
(10) National Guidelines – Drinking Water – Aesthetic Objective
Canadian Water Quality Guidelines for the Protection of Aquatic Life, CCME 2006.
(11) National Guidelines – Freshwater Aquatic Life

6.3 MITIGATION AND MONITORING

It is not expected that the continued operation of the Brandon G.S. (Unit 5) will result in any adverse effects on the local wildlife, wildlife habitat and vegetation. The groundwater monitoring program indicates that water quality has not been significantly affected by the coal stockpile. Arsenic is elevated in groundwater near the ash lagoon; however, additional monitoring is proposed. Water quality in the Assiniboine River will not be affected by elevated arsenic concentrations in the groundwater.

6.3.1 WILDLIFE

There is no additional mitigation or monitoring proposed.

6.3.2 VEGETATION

The only endangered plant species that has the possibility of being present within the wooded area north of the ash lagoon is the small lady's slipper as ideal habitat conditions are within the distribution range where the Brandon G.S. is located. As a mitigative measure, Manitoba Hydro will endeavour to maintain the wooded area in its natural state.

With respect to the entire Brandon G.S. site, there is no additional mitigation or monitoring proposed.

6.3.3 GROUNDWATER

The groundwater monitoring program results indicate that arsenic in groundwater, first observed in 2003, has increased near the ash lagoon, but that it is not adversely affecting the Assiniboine River due to groundwater seepage.

Based on the groundwater findings, Manitoba Hydro has undertaken investigations to assess the integrity of the engineered liner under the ash lagoon. The clay liner on the east portion of the lagoon was surveyed in the spring of 2006. Areas found deficient had clay added to improve its integrity and ensure that it meets standard compaction guidelines. Groundwater monitoring beyond 2006 is required to determine the effectiveness of the 2006 mitigation measures.

Therefore, the groundwater monitoring program will continue, consistent with the current program; additional monitoring wells will be added to the groundwater monitoring program, primarily between the ash lagoon and the river, as a precautionary measure to confirm that there is no effect on the river due to groundwater flow from the study area. The additional wells will primarily confirm the interpretation of a lack of adverse affects to the groundwater resources and the river. The monitoring data from the existing monitoring wells beside the lagoon indicate localized affects to groundwater but nothing beyond (Appendix P).

The west cell of the ash lagoon is no longer in service and progressive decommissioning activities, including site grading to promote precipitation surface runoff and minimize downward percolation, capping, and seeding have and are taking place. Inspection and maintenance of the lagoon cells will continue, consistent with the current program.

There are no anticipated changes to the operation of the coal stockpile. Based on this assessment, no additional mitigation is proposed for the coal stockpile.

6.4 SUMMARY OF RESIDUAL EFFECTS

Table 6-2 summarizes residual effects of operation of Unit 5, and describes each effect in terms of the magnitude, spatial extent of area affected, duration, frequency, and potential for a measurable effect to the physical environment.

Table 6-2 Residual Effects of the Operation of the Brandon G.S. on the Physical Environment

Source of Effect	Description of Effect	Mitigation Measures	Residual Effect
Ash Lagoon	On-going utilization of current east lagoon cell for storage of ash and presence of the decommissioned west lagoon cell has the potential to affect ground and surface water quality. Elevated concentrations of arsenic were found in some of the groundwater monitoring wells along the north side of the ash lagoon. Adverse effects due to groundwater seepage to the river are not expected.	The lagoon liner on the east cell of the lagoon was repaired in 2006. The rehabilitation of the west cell of the ash lagoon will include contouring and capping which will have a positive effect on the environment. The groundwater monitoring program will continue, consistent with the current program. Additional monitoring wells will be added to the groundwater monitoring program to confirm that there is no effect on the river due to groundwater flow from the study area.	The residual effect of continued operation of the ash lagoon is negligible to small after proposed mitigation and monitoring was/is put in place.
Coal Stockpile	Results from the groundwater monitoring program indicate that the continued operation of the coal stockpile is not expected to result in any significant effects to local groundwater quality	No additional mitigation is proposed.	The residual effect is negligible.

Source of Effect	Description of Effect	Mitigation Measures	Residual Effect
Long-term presence of station (continued operation).	On-going activity and human presence at the station site will have no effect on vegetation, terrestrial biology, wildlife, and wildlife habitat.	Manitoba Hydro will endeavour to maintain the wooded area north of the ash lagoon in its natural state.	The residual effect is negligible.

CHAPTER 7

SOCIOECONOMIC ENVIRONMENT

7.0 SOCIOECONOMIC ENVIRONMENT

7.1 EXISTING ENVIRONMENT

The Brandon G.S. is located on the eastern outskirts of the City of Brandon in Southwestern Manitoba, approximately 200 km west of the City of Winnipeg. The City of Brandon (Brandon) is located in the Rural Municipality of Cornwallis. Brandon is the primary population centre for Southwestern Manitoba. It serves approximately 180,000 regional residents and is the dominant socio-economic hub for regional trade.

7.1.1 THE CITY OF BRANDON

Brandon is the second largest city in Manitoba. The population of Brandon is approximately 41,000[17]. Of this, a labour force of 22,300 resides in Brandon with an almost equal amount residing in rural areas surrounding Brandon.

Single-detached dwellings are the predominant form of housing, with multiple low-density dwellings also making up a significant portion of the housing. The number of apartment dwellings of five stories or more is relatively low.

The Brandon and Area Planning District is responsible for community planning and business development in Brandon. Two fire stations in Brandon are fully equipped for various fire, rescue and emergency medical response situations. Brandon has its own police force, complemented by the RCMP who have jurisdiction over rural areas.

The Regional Health Authority is responsible for providing health care services. Brandon serves as a regional referral center for Southwesterm Manitoba. Brandon General Hospital services the City and surrounding rural area, providing both emergency services and geriatric care.

Brandon School Division Number 40 is responsible for the public schooling of students in the Brandon area, operating 22 schools. Post secondary education is available from a combination of public and private institutions ranging from a community college and University to specialized vocational training schools including the Manitoba emergency services college and private vocational schools that serve the region's education and training needs.

7.1.2 RURAL MUNICIPALITY OF CORNWALLIS

The Rural Municipality of Cornwallis surrounds the City of Brandon. CFB Shilo is located on the Municipality's eastern edge. The R.M. of Cornwallis website lists the population of the municipality at approximately 4300, located in several communities and on rural farms.

7.2 ECONOMY

Brandon acts as the central trading centre for the entire southwestern Manitoba region with a Labour Market Area consisting of 27 jurisdictions. With approximately 2000 businesses, it serves as the service

[17] All statistics 2001 Statistics Canada, unless otherwise noted.

centre for the region. Of the Brandon labour force, the median family income is just over $49,000 ($2001) and the 2006 unemployment rate is 4.7%.

7.3.1 ECONOMIC CONTRIBUTORS

The largest sectors of the Brandon economy include Agriculture, Manufacturing and Construction, Wholesale and Retail, and Health and Education. Brandon is home to more than 350 businesses and a federal agricultural research station that directly serve the agricultural marketplace. Of the labour force residing in Brandon, the majority choose to work in Brandon.

Brandon's largest manufacturing employers are Maple Leaf Pork, Koch Fertilizer Canada Ltd. (formerly Simplot Canada), A.E. McKenzie Seed Company, Behlen Industries, Inventronics, Canexus Limited and Wyeth Organics.

Other significant economic drivers in Brandon are fertilizer production, federal, provincial and municipal government, chemical production, metal fabrication and health care. CFB Shilo is a military facility located approximately 30 km from Brandon. It is a ground, artillery and mechanized troop-training base employing approximately 1430 military and 440 civilians.

7.3.2 FUTURE PLANS

There are current plans for Shape Foods Inc. to construct a plant to produce Omega 3 Oil from flax seed. This plant will be close to the Brandon G.S. on Victoria Avenue East.

In July 2006, construction began on a Renaissance Station in downtown Brandon. The development will include sixty-six condominiums and over 2300 m^2 of commercial space.

A new senior's complex containing 134 suites is expected to be open in March 2007.

7.3 SOCIOECONOMIC EFFECTS

Environmental effects associated with continuing operation of the station have been identified as negligible and/or mitigable; therefore, negative socioeconomic impacts that may arise because of Unit 5-related environmental effects are also expected to be minor in nature. Other socioeconomic effects from continuing operation of Unit 5 are expected to be positive and are listed below.

Brandon G.S. is responsible for the direct employment of a workforce of up to 88 people and the indirect employment of another 21 individuals in Winnipeg. Of the staff working at Brandon G.S. the majority are employed in the operation of Unit 5. 89% percent of the staff working at Brandon G.S. staff live in the City of Brandon or the R.M of Cornwallis. In addition, approximately five full-time positions at CP railway are required for local coal transportation and handling.

It is estimated that the operation of Unit 5 contributes through salaries and purchased material and services between $5 and $6 million dollars to the local economy annually and an additional $1 and $2 million in Winnipeg.

Additional economic benefits are realized in grants in lieu of taxes to the City of Brandon and the economic activity generated by special maintenance and capital projects related to the ongoing operation of Unit 5.

7.4 MITIGATION AND MONITORING

There are no negative socioeconomic effects resulting from the operation of the Unit 5 that require mitigation or monitoring.

7.5 RESIDUAL EFFECTS AND SIGNIFICANCE

There are no negative residual socioeconomic effects resulting from the operation of Unit 5.

CHAPTER 8

HEALTH, SAFETY AND EMERGENCY RESPONSE

8.0 HEALTH, SAFETY AND EMERGENCY RESPONSE

This chapter examines administrative aspects of the Brandon G.S., which includes a comprehensive review of workplace health and safety measures in place at the Brandon G.S. as well as an overview of emergency response procedures and the ISO 14001 environmental management system. Additionally, the effects of malfunctions and accidents with corresponding mitigation measures for activities related to the operation of Unit 5.

8.1 WORKPLACE HEALTH AND SAFETY

8.1.1 PROGRAM OVERVIEW

The legal responsibility for safety at Brandon Generating Station is prescribed by the *Workplace Safety & Health Act* W210, Section 40, and *Manitoba Regulation 106/88R*. The Brandon Generating Station Workplace Safety & Health Committee 13 oversees the safety program at Brandon Generating Station. The committee is made up of management and worker representatives.

Occupational risks from the routine operation and maintenance of Brandon G.S. are broadly categorised as follows:

- Accidents - direct occupational injuries from routine operation and maintenance.
- Occupational Health – issues such as: (i) delayed potential increases in cancer and other chronic diseases from respiration of particles and exposure to chemicals and asbestos and (ii) loss of hearing in workers engaged in routine operation and maintenance.

The safety program is governed by the Corporate Safety and Occupational Health Rules and administered through the Safety Management System to fulfil the “Safety Program” requirements of the *Workplace Safety and Health Act* W210. The Safety Management System is a Corporate-wide tool for managers and Workplace Safety & Health Committees to use for planning and carrying out actions that will ensure the safety and health of employees. The system is divided into four sections: (i) managing culture, perception, knowledge, and behaviour, (ii) managing work processes, (iii) managing the hazards of the physical environment, and (iv) assessing effectiveness.

Management of the physical environment contains the following elements:

- Workplace Safety & Health Inspections
- Workplace Hazardous Materials Information System (WHMIS
- Asbestos Containing Material and Man Made Mineral Fibre18
- Releases-Response & Prevention
- Transportation of Dangerous Goods
- Hazardous Waste

[18] A medical surveillance programme consistent with legislated requirements is in place for all permanent Brandon G.S. employees.

- Hearing Conservation19
- Fall Protection
- Workplace Environment.

Within the Brandon G.S. buildings, appropriate hearing protection is required and exposure limits have been established for staff. Signs are installed at all areas of the Brandon G.S. where hearing protection is required.

8.1.2 ROLES AND RESPONSIBILITIES

Within Manitoba Hydro it is line management's responsibility to ensure a safe and healthy workplace for staff. Compliance with the legislated requirements relating to safety is achieved through a process shared by the following groups within Manitoba Hydro. These groups form Manitoba Hydro's Internal Responsibility system and include workers, line management, the Workplace Safety and Health (WH&S) committees, Field Safety Officers, Employee Safety and Health Department, and the Corporate Safety and Health Committee. Roles and responsibilities of each group are as follows:

- Line Management - to ensure a safe and healthy workplace for all employees as *per* section 4(2) of W210 The *Workplace Safety and Health Act* and Section 109 of the Corporate Safety and Occupational Health Rules.
- Workers - responsible for their own safety and health and the safety and health of their fellow workers as *per* section 5 of W210 The *Workplace Safety and Health Act* and Section 110 of the Corporate Safety and Occupational Health Rules.
- Workplace Safety and Health Committees - as required by legislation, this joint worker-management committee cooperatively addresses issues to make the Corporation safer and healthier. Roles include providing a forum for the resolution of safety and health concerns of employees and management, conducting workplace inspections, and accident investigation.
- Field Safety Officers - assist line management and WS&H committees in their responsibility to ensure a safe and healthy workplace through delivery of programs implemented by Employee Safety and Health Department and ensuring WS&H committees are effective and successful.
- Employee Safety and Health Department - deliver systems and services that provide prevention of accidents and incidents thereby minimising risks to people, property and the environment.
- Corporate Safety and Health Committee - a steering committee made up of senior managers and bargaining unit executives to provide a forum for the Corporate-wide monitoring of the effectiveness of safety policies and practices and for initiating any enhancements necessary to attain Corporate safety targets.

[19] Audiometric testing is conducted regularly for all Brandon G.S. employees.

8.1.3 CORPORATE PROGRAMS

The Employee Safety and Health Department with its staff of approximately 32 provides leadership for Manitoba Hydro's corporate safety programs. These programs include Environmental Health, Fire Protection, Employee Assistance, Health and Wellness, Workplace Safety, WCB Administration, and implementation for new programs such as Job Planning and Behaviour Based Safety. The Employee Safety and Health Department is responsible for the development and maintenance of safety policy, the Safety Rule Book, and any new programs which are implemented corporate-wide such as Fall Protection, Equipotential Bonding and Grounding, Hearing Protection, Spill Response, and the Safety Management System.

8.1.4 ACCIDENTS/CONTINGENCIES

Workplace accidents are reported within Manitoba Hydro using the Supervisor's Report of Injury (internal) Form and to the Workers Compensation Board of Manitoba using their WCB Form 2. Manitoba Hydro has a formal accident investigation process which is used by Workplace Safety and Health committees and Field Safety Officers to document the details of workplace accidents and make recommendations to management regarding changes and improvements to prevent similar occurrences wherever possible. Lost time accidents, non-lost time accidents, vehicle accidents, accident frequency, and accident severity for all Corporate Business Units are compiled and managed by Employee Safety and Health using the Safety Net information system.

8.2 EMERGENCY RESPONSE

Brandon G.S. establishes and maintains emergency response plans and procedures to identify potential for, and respond to, accidents and emergency situations. The emergency response plan is consistent with the requirements of corporate policy, clause 26 of *Environment Act* Licence 2497R[20], ISO 14001, and *Canadian Environmental Protection Act* (CEPA) Environmental Emergency (E2) regulations[21]. The plan is reviewed, revised, and tested regularly.

Specific emergency response procedures are documented in the Station Manual described as "Brandon Generating Station, Emergency Response Plan" (ERP).

The ERP is a controlled document and is continually kept current regarding names of key contacts, phone or cellular numbers, and procedures. A current copy is always provided to Manitoba Conservation district office staff.

8.2.1 FIRE FIGHTING RESPONSE

Brandon G.S. maintains a volunteer fire crew, referred to as the Emergency Response Crew (ERC) and is consistent with corporate policy. Each member spends a minimum of 48 hours per year training in theory and practical exercises according to a documented schedule. All members of the Brandon ERC are

[20] *Environment Act* Licence 2497R refers to the licence issued for operation of the Brandon Combustion Turbine Plant. The plant is a separate facility co-located with Unit 5 on the Brandon G.S. site.
[21] The Statement of Certification has been submitted to Environment Canada.

accredited Level 1 (US) National Fire Protection Association 1001 1997 Fire Fighters. In addition, some members belong to the provincial Urban Search and Rescue (USAR) team. Fire fighting equipment is maintained on-site in the event of an emergency. In addition, the station has a mutual aid agreement with Brandon Emergency Support Team (BEST). All station staff receive Fire Prevention and fire extinguisher application training.

Actions to be taken during the fighting of a fire are given in the Emergency Response Plan within the "First Response & Contacts" tab. Detailed fire fighting roles and responsibilities are provided in the Fire Alarm Procedure flow chart.

Fire fighting equipment at the generating station is kept in a state of good repair and ready for use under the station maintenance program. Funds are allocated in the station budget to address deficiencies in equipment and to purchase new and/or updated equipment as required. Generating station equipment includes fixed pumps, hydrants, and deluge systems, along with a response van equipped with full personal turn-out gear.

Generating station management is committed to the support of the Fire Crew at the Brandon G.S. When necessary, resources are made available to upgrade core knowledge, skills, and equipment. Management will continue to send participants to the Emergency Services Conference, Manitoba Hydro Annual Fire Fighting Skills Competition, and Brandon Emergency Support Team (BEST) joint training exercises to facilitate learning new standards and for refining existing skills.

8.2.2 SPILL RESPONSE

The Brandon G.S. is currently equipped with on-site spill response capability to respond to spills of petroleum products and hazardous materials used at the station. This consists of a trained emergency response team, an ongoing training program for the response team, a site-specific Spill Response Plan, and spill response equipment. Equipment includes:

- Spill response trailer
- Zodiac boat with outboard motor
- Oil booms for spill containment on water
- Spill vacuum
- Immediate response equipment drums located at strategic locations throughout the station

The Brandon G.S. has a designated emergency response team that is trained and equipped to contain, stabilise, and clean-up spills of petroleum products, sulphuric acid, caustic soda and other commonly used hazardous materials that may spill inside the powerhouse or on station grounds. The team is also trained and equipped to contain products that may enter the Assiniboine River.

The spill response team receives formal training at least once every three years, consisting of both theory and hands-on drills for simulated spills. In addition, once each year the team normally conducts practice drills for various spill response procedures including the setting of booms on the Assiniboine River. All station staff receive general awareness spill response training once every three years. A well-equipped spill response trailer and boat is maintained at Brandon Generating Station ready to respond.

For spills within the powerhouse and station grounds, the station is equipped with a variety of absorbent materials, personal protective equipment, dyking material, hazardous waste drums, and heavy equipment for earth moving and neutralising chemicals. For spills to surface water bodies, the station has equipment on a trailer that can be deployed downstream of the spill location. The equipment includes 200 m of containment boom with accessories, zodiac boat and motor, and cold weather floatation suits.

The Brandon G.S. Spill Response Plan component of the ERP documents spill reporting procedures, personal safety measures, and site-specific containment procedures for spill occurrences on both land and to water. It is reviewed by staff during training sessions and is updated regularly.

The Spill Response Plan covers:

- Lubricating and Seal Oil Systems
- I.D. Fan House and Main Building
- Lubricating Oil and cooling water Systems
- Water Treatment Plant Chemicals
- Sulphuric Acid in the Battery Room
- Hydrazine
- Station Transformers
- Non-PCB Oil in Switchyard
- PCB Oil in Switchyard
- Condenser Cooling Water Pump House Chemicals
- Fuel Oil/Diesel Storage Tanks
- Spills to the Assiniboine River
- Glycol in Heat Exchangers

8.3 ENVIRONMENTAL MANAGEMENT SYSTEM

8.3.1 INTERNATIONAL STANDARDS ORGANIZATION (ISO) 14001:2004

The Brandon G.S is part of the Manitoba Hydro Power Supply Business Unit ISO 14001 registered Environmental Management System (EMS). The Power Supply EMS incorporates the corporate Environmental Management Policy[22] as its guiding statement. The EMS defines how business unit activities can potentially affect the environment. These “significant aspects” are: water quality, waste generation, energy and material use, releases in the form of spills, water management, land management and processes that utilise PCBs.

The EMS is used to manage the business unit’s environmental aspects. It provides the framework for the continual development and integration of environmentally responsible practices into the Brandon Generating Station’s Business Plan. Regular EMS reviews occurs at the station.

[22] The Environmental Management Policy can be found at http://www.hydro.mb.ca/environment/policy_ems.shtml

The Power Supply EMS, and specifically the Brandon G.S., have undergone internal audits and audits by Manitoba Hydro's external ISO 14001 registrars. Audits identify opportunities for improvement of environmental performance. Audits can also identify systematic non-compliances with the ISO standard.

The Power Supply EMS achieved third-party registration in February 2003, thereby demonstrating conformity with the requirements of ISO 14001. Registrations must be re-assessed approximately every three years; the Power Supply EMS is currently undergoing re-registration.

8.3.2 ENVIRONMENTAL MANAGEMENT PRACTICES

The significant environmental aspects that apply to the Brandon G.S. include air emissions and noise abatement, waste and hazardous materials management, liquid effluent and discharge management, water management, energy and material use, and land use. The identified effect on the environment, relevant legislation, operational controls, and monitoring and measurement requirements for each significant environmental aspect are documented. The major aspects are reviewed and revised by the Brandon G.S. Management Team quarterly. As every employee's work-related duties have the potential to affect the environment, EMS awareness sessions are presented to every employee.

In addition to the environmental management programs for the identified significant aspects, the Brandon G.S. implements and maintains comprehensive programs for PCB control and asbestos management.

In response to the June 2002 Fisheries Habitat Compensation Proposal: Assiniboine River Brandon, Manitoba Hydro submitted to the Department of Fisheries and Oceans, specific vegetation restoration steps have been taken around the Brandon G.S. Access to the area has been restricted, by way of strategic placement of boulders, to allow establishment of vegetation. Topsoil was placed in the area and subsequently seeded. The vegetative cover is evidence of the success of this planting. Willows were planted over approximately 200 m^2, including along the shoreline. The willow growth has not been established and will subsequently be repeated, while ensuring a more robust planting and maintenance strategy, in 2006.

8.3.3 MONITORING AND CONTINUOUS ENVIRONMENTAL IMPROVEMENT

Manitoba Hydro is committed to being a leader in environmental protection. Where Manitoba Hydro's ongoing monitoring and assessment indicates that station environmental performance can be improved, measures are taken to investigate possible solutions. Where feasible, solutions will be included in the station's business plan and implemented voluntarily. For more significant environmental improvements, Manitoba Hydro will advise the regulator of plans that might affect the terms and conditions of the prevailing *Environment Act* Licence, should the regulator desire to make amendments to the Licence.

Under the terms of the operating licence granted by Manitoba Conservation and Power Supply's EMS, extensive monitoring and measurements are undertaken and reported. The items that are measured, calculated, monitored, and/or reported (as required) include flow rates, air emissions, groundwater quality, water quality, fuel consumption, PCB disposal volumes, asbestos fibre analysis, and spill/release incident reports.

8.4 EFFECTS OF MALFUNCTIONS AND ACCIDENTS

Brandon G.S. management staff are responsible for maintenance planning, performing the maintenance work, and station records management. Both electronic and hardcopy maintenance and calibration records are maintained for approximately two thousand equipment items. Equipment maintenance is carried out by qualified technicians. Where redesign of Brandon G.S. equipment or processes are required, the station is supported by a central Generation Maintenance Engineering group of about 35 engineers and technicians.

Brandon G.S. is operated by provincially licenced Power Engineers. Brandon G.S. Unit 5 is operated in compliance with the *Steam and Pressure Plants Act* and the *Power Engineers Act*. In-spite of the above, all man-made systems have some risk of failure. Table 8.1 indicates how the estimated risk of accidents and malfunctions, related to Unit 5 operation, was calculated in Table 8.2, based on probability of occurrence and consequence. The resulting risk was assessed following the application of all mitigation efforts and the modifications proposed in Section 2.5.

After mitigation efforts and the implementation of the proposed modifications all risks of significant accidents and malfunctions related to operation of Unit 5 are judged to be acceptable.

8.5 SUMMARY AND CONCLUSIONS

The Brandon G.S. line management ensures a safe work environment and that employees are qualified, have required safety equipment and that they understand and apply safe working rules and practices to minimise the risk of injury. Employees are responsible for taking all necessary actions to protect themselves and their fellow workers, including refusing to perform work deemed to be unsafe. Brandon G.S. staff are familiar with basic emergency response procedures, including First Aid, CPR, building evacuation, use of fire extinguishers, and Workplace Hazardous Materials Information System (WHMIS).

The Brandon G.S. establishes and maintains emergency response plans and procedures to identify potential for, and respond to, accidents and emergency situations. Brandon G.S. maintains a Level 1 (US) National Fire Protection Association 1001 1997 Emergency Response Crew and complementary fire-fighting equipment. The crew also contains members trained and equipped to contain, stabilise, and clean-up hazardous material releases inside the powerhouse, on station grounds, and/or to the Assiniboine River.

The Brandon G.S. is part of the Manitoba Hydro Power Supply ISO 14001-registered Environmental Management System. The system is audited internally and externally and is used to facilitate continuous improvement in environmental performance.

The estimated risk of accidents and malfunctions related to Unit 5 operation was assessed and, considering proposed modifications, judged to be acceptable.

Table 8-1 Risk Matrix

Consequence	Probability of Occurrence			
	High	**Medium**	**Low**	**Very Low**
High	Unacceptable	Unacceptable	Not Desirable	Acceptable
Medium	Unacceptable	Not Desirable	Acceptable	Acceptable
Low	Not Desirable	Acceptable	Acceptable	Acceptable
Very Low	Acceptable	Acceptable	Acceptable	Acceptable

Table 8-2 Risk of Accident Considering All Mitigation Measures

Hazardous Material	Mitigation	Probability of Occurrence	Consequence	Risk
Asbestos	Follow Disposal Procedures, Double Bagging, Approved Landfills.	Very Low	Very Low	Acceptable
Ash Lagoon pH treatment	Maintain revised operating procedures and practices designed to mitigate against accidents of this nature. Continuously improve on operating procedures and practices. The ash lagoon re-development will mitigate this risk to acceptable through improved equipment and processes.	Very Low	High	Acceptable
Coal - Spontaneous combustion in coal stockpile	The burning area is excavated from the pile and the fire is extinguished. The extinguished coal is introduced into the boiler through the fuel feed system.	High	Very Low	Acceptable
Corrosion Inhibitor	Tank containment, relatively low flow beyond containment	Low	Low	Acceptable
Corrosion Dispersant	Tank containment, relatively low flow beyond containment	Low	Low	Acceptable
ESP Field – Loss of 2 fields/one side	Repairs as soon as problem occurs.	Low	Low	Acceptable
ESP Field – Loss of 3 fields/one side	Unit 5 is shutdown, the ESP is repaired and returned to service.	Low	Medium	Acceptable
Fuel Oil for Diesel Fire Pumps	Tank in basement of Water Treatment with containment & containment around pump.	Low	Low	Acceptable
Fuel Oil - Tank Farm	2.4 million litres in two tanks, containment, buried piping double walled, inside pumphouse any leaks would go to mitigation building. No floor drains in transfer building, has sump with oil detection.	Very Low	High	Acceptable

Hazardous Material	Mitigation	Probability of Occurrence	Consequence	Risk
Fuel Oil - Raw Water Pumphouse	Double wall tank with manual leak detection	Low	Low	Acceptable
Glycol - Crusher House Heating	Approximately 1000 liters in tank on dearator floor and piping down conveyors.	Medium	Very Low	Acceptable
Hydrazine - *(current)* Low concentration	Boiler drains tested before discharge, review need for continuous monitoring.	High	Very Low	Acceptable
Hydrazine - High concentration	Containment curb, special handling pumps.	Very Low	High	Acceptable
Insulating Oil	Containment, Fire Protection.	Low	Low	Acceptable
Lube Oil - Balance of Plant	a) All floor drains pass through the oil mitigation building; b) Secondary Cooling (boiler feed pump and induced draft fan bearings): Secondary closed loop cooling system prevents an oil leak entering the circulating cooling water system (i.e. cooling tower); c) Direct Cooling (pulverizer oil coolers): In the event of an oil leak to the cooling water, oil would enter the circulating cooling water system (cooling tower). The cooling tower blowdown discharges to the ash lagoon where fugitive oil emissions can be contained and cleaned up.	Medium	Low	Acceptable
Lube Oil - Turbo Generator /Seal Oil/Governor Oil	a) All floor drains pass through the oil mitigation building. b) Direct Cooling (turbine bearings, seal oil, and governor oil): In the event of an oil leak to the cooling water, oil would enter the circulating cooling water system (cooling tower). The cooling tower blowdown discharges to the ash lagoon where fugitive oil emissions can be contained and cleaned up.	Medium	Low	Acceptable

Hazardous Material	Mitigation	Probability of Occurrence	Consequence	Risk
Lube Oil Raw Water Pumphouse	Maximum system spill of 16 - ½ Gallons – total 4 gallons (18.2 liters). A spill would be reportable but small.	Low	Low	Acceptable
Natural Gas - Auxiliary Boilers	The operation and maintenance of the auxiliary boilers are governed under Provincial Regulations.	Low	Low	Acceptable
PCB	PCB locations identified, systematic replacement program.	Low	Low	Acceptable
Phosphate	Tank containment, the area is checked daily by operations staff.	Low	Low	Acceptable
Sodium Hydroxide	Tank containment, can stop spill at chemical waste sump, low volumes.	Low	Low	Acceptable
Sodium Hypochlorite	Tank containment, alarm in containment, relatively low flow beyond containment.	Low	Low	Acceptable
Sulphuric Acid	Two tanks both have containment, floor drains go to chemical waste for water treatment tank.	Low	Low	Acceptable

CHAPTER 9

LICENCE REVIEW

9.0 LICENCE REVIEW

This chapter reviews the existing Environment Act Licence (1703R) and suggests modifications where terms and conditions no longer apply or have become out-dated. Each clause of the licence is individually reviewed and suggestions are offered to align the terms and conditions with the conclusions of the environmental assessment undertaken for Licence Review.

9.1 OVERVIEW OF LICENCE REVIEW

Manitoba regulatory authorities issued the current Environment Act Licence for the Brandon Generating Station in October 1993 with one revision occurring in 1994. The initial Licence was prepared after submission of an Environment Act Proposal in 1990 and a three volume Environmental Impact Assessment report in 1992 and 1993. The 1994 licence revision consisted of a modification to the specified effluent quality parameters requiring analyses.

At the time that Licence 1703R was issued, Brandon G.S. was comprised of 5 units. With the retirement of Units 1-4, the Licence now pertains only to the operation of Unit 5 and its related systems. In 2002, Environment Act Licence 2497R was issued to cover the operation of Units 6&7 and any related infrastructure and/or systems constructed in association with Units 6&7.

All monitoring and studies stipulated in Licence 1703R have been undertaken and the required reports have been submitted to the Director. When the Director has requested additional information, it has been provided. Reputable consultants have been retained as required to supplement Manitoba Hydro's data, information and expertise to respond to information and analysis requirements.

A copy of the current licence (No. 1703R dated February 14, 1994) is included in Appendix A. The purpose of this chapter is to consider the results of the environmental and risk assessments contained herein and the conclusions of each, and to identify where the current licence can be amended. The entire licence has been reviewed on a clause-by-clause basis to identify where deletions, additions or modifications to terms and conditions can be incorporated based on current and future operation of Unit 5.

Since Licence 1703R was issued in 1993, the following emissions control upgrades have been undertaken for:

- Airborne particulate matter - cyclone system replaced by an electrostatic precipitator; and
- Heat loading of cooling water into the Assiniboine River - once-through steam condenser system converted to a closed-loop system employing a cooling tower.

With the retirement of Units 1-4, the implementation of additional systems and the completion of all of the monitoring and studies, there are many clauses in the existing licence that apply to one-time actions that have been completed and therefore no longer apply to current operations, or which can be updated to reflect and be relevant to current operations.

Following each of these clauses, Manitoba Hydro proposes one of three actions for consideration by Manitoba Conservation:

- Retain the licence clause as is;
- Revise the licence clause (where this is recommended, Manitoba Hydro has provided suggested text for the revised clause); and
- Remove the licence clause entirely.

Each action is followed by a short statement on the rationale used to support the action and a reference to the appropriate section of this EIS that supports the revision or deletion.

9.2 CLAUSE BY CLAUSE REVIEW

For the following sections, text presented in box italics indicates word-for-word reproduction of the text of Environment Act Licence 1703 R. Text presented in **bold underline** indicates suggested revisions to the wording of the licence clauses, or new clauses to be added to the licence.

9.2.1 PREAMBLE

IN ACCORDANCE WITH THE MANITOBA ENVIRONMENT ACT (C.C.S.M. c. E125)
THIS LICENCE IS ISSUED TO:

MANITOBA HYDRO; "*the Licencee"*

for the rehabilitation, upgrading and continuing operation of the existing Development, being the Brandon Thermal Generating Station as outlined in the Licencee's Proposal dated September 24, 1990, and the Environmental Impact Assessment report (Volumes I and II) dated August, 1992, and the addendum Volume III dated January, 1993, and located in the SW ¼ Section 20, Township 10, Range 18, WPM in the City of Brandon, Manitoba, and subject to the following specifications, limits, terms and conditions:

Recommendation: It is recommended that Manitoba Conservation **revise** this paragraph, based on the updated information presented in this report, and to include descriptions to clarify that the scope of the licence applies to Unit 5 and its related systems, whereas Units 6&7 are governed by a separate Environment Act Licence.

9.2.2 DEFINITIONS

Several definitions have been identified for modification, deletion and/or addition, as follows:

Accredited laboratory – add a reference to CAEAL accreditation

Fugitive emissions – The suggested revised definition would read "Particulate matter **which could not reasonably pass through a stack, chimney, vent, or other functionally-equivalent opening, that have the potential to be measured or be visible at the plant boundary."** The revised definition corresponds to suggested revisions to Clause 10.

Heat input –The suggested revised definition would read "**means heat derived from combustion of fuel in a steam generating unit and does not include the heat input from preheated combustion air, recirculated flue gases, or exhaust gases from other sources, such as gas turbines, internal combustion engines, kilns, etc.**". The purpose of this change is to utilize the CCME definition for heat input, from 40 CFR 60 Section DB.

Hour – the licence definition reads "means any time span consisting of 60 consecutive minutes". The revised definition would read "**means any time span consisting of 60 consecutive minutes, or a calendar hour for the purposes of the Continuous Emissions Monitoring System**". The purpose of this revision is to define an hour in terms suitable for the CEMS.

9.2.3 GENERAL SPECIFICATIONS

1. Notwithstanding any of the following limits, terms, and conditions specified in this Licence, the Licencee shall, upon the request of the Director:

(a) sample, monitor, analyze and/or investigate specific areas of concern regarding any segment, component or aspect of pollutant storage, containment, treatment, handling, disposal or emission systems, for such pollutants or ambient quality, aquatic toxicity, leachate characteristics, and discharge rates, for such duration and at such frequencies as may be specified.

(b) determine the environmental impact associated with the release of any pollutants from the said plant; or

(c) provide the Director, within such time as may be specified, with such reports, drawings, specifications, analytical data, flow rate measurements and such other information as may from time to time be requested.

Recommendation: Manitoba Hydro recommends that Clause 1 be **retained** with the present wording.

2. The Licencee shall carry out all analyses on liquid samples in accordance with the methods prescribed in the most current edition of "Standard Methods for the Examination of Water and Wastewater" published jointly by the American Public Health Association, the American Waterworks Association and the Water Pollution Control Federation, unless otherwise specified in this Licence or by the Director.

Recommendation: Manitoba Hydro recommends that Clause 2 be **retained** with the present wording.

3. The Licencee shall ensure that all monitoring activities, data collection and interpretations requested through the provisions of this Licence are carried out by individuals properly trained or qualified to carry out these tasks.

Recommendation: Manitoba Hydro recommends that Clause 3 be **retained** with the present wording.

4. The Licencee shall report all data requested through this Licence in a manner and form acceptable to the Director.

Recommendation: Manitoba Hydro recommends that Clause 4 be **retained** with the present wording.

9.2.4 SPECIFICATIONS, LIMITS, TERMS AND CONDITIONS

Respecting Air

5. The Licencee shall not burn coal to operate any power generating unit in the generating mode unless the air emissions from the boiler furnace associated with that unit are directed through a fully functional and operating cyclone or some other equivalent or superior particulate matter emission control device.

Recommendation: Manitoba Hydro recommends that Clause 5 be **replaced**. The purpose of the suggested replacement is to update the clause to specifically reflect the ongoing use of an electrostatic precipitator (ESP), which replaced previous particulate control equipment in 1996, and to adjust the wording to refer to Unit 5, the only remaining, functioning generating unit. In practice, Unit 5's normal operating range is dictated by the operating range of the ESP. The clause is further revised to reflect this.

> The suggested revised wording is "**Particulate emissions from the combustion of coal must be controlled by an electrostatic precipitator (ESP) during normal sustained unit operation."**

6. The Licencee shall limit the emission of pollutants from any active stack serving the power generating units on the plant site to the extent that:

- *(a) the emission of sulphur dioxide does not exceed 890 nanograms per Joule (2.07 pounds per million BTU) of heat input associated with the respective stack;*
- *(b) the emission of nitrogen dioxide (expressed as nitrogen dioxide, NO_2) do not exceed 258 nanograms per Joule (0.6 pounds per million BTU) of heat input associated with the respective stack;*

as determined from any stack emission test carried out in accordance with procedures and methods satisfactory to the Director.

Recommendation: Manitoba Hydro recommends that the preamble for Clause 6 be **revised** to reflect the use of a single stack by Unit 5.

> The suggested revised wording is: "*The Licencee shall limit the emission of pollutants from* **the stack** *to the extent that:"*

Recommendation: Manitoba Hydro recommends that Clauses 6(a) be **revised** to reflect the emission rate for SO_2 on a kg/MWh output basis. The recommended rate is 3.29 kg SO_2/MWh output (720 hour rolling average). The rate of 3.29 kg SO_2/MWh is equivalent to the greatest stack emission rate utilized in

the Ambient Air Quality Assessment and the Environmental and Human Health Risk Assessment, which concluded no measurable environmental effects (For further information, refer to Section 5.4).

> The suggested revised wording is "*the emission of sulphur dioxide does not exceed* **3.29 kg SO_2/megawatt-hour output on an hourly basis (720 hour rolling average)"**

Recommendation: Manitoba Hydro recommends that Clause 6(b) be **revised** to reflect the emission rate for NO_x on a kg/MWh output basis. The recommended rate is 2.97 kg NO_x/MWh output (720 hour rolling average). The rate of 2.97 kg NO_x/MWh is equivalent to the greatest stack emission rate utilized in the Ambient Air Quality Assessment and the Environmental and Human Health Risk Assessment, which concluded no measurable environmental effects (For further information, refer to Section 5.4).

> The suggested revised wording is "*the emission of nitrogen oxides (expressed as nitrogen dioxide, NO_2) do not exceed* **2.97 kg NO_x/megawatt-hour output on an hourly basis (720 hour rolling average)"**

Recommendation: Manitoba Hydro recommends that the clause conclusion be **revised** to clarify that the said limits only be applied to periods outside of start-up, shutdown or load ramps to/from no load to minimum sustainable load on Unit 5.

> The suggested revised wording is "*as determined* **by the Continuous Emissions Monitoring System that operates** *in accordance with procedures and methods satisfactory to the Director.* **The said limits shall apply to all periods of generation other than during periods of start-up, shutdown or load changes to or from no load to minimum sustainable load."**

7. The Licencee shall replace the existing mechanical dust collectors from generating Unit 5 with an ESP having a rated 99.5% particulate matter removal efficiency, within an implementation and testing schedule such that the ESP is set into service by no later than January 1, 1996.:

Recommendation: Manitoba Hydro recommends that Clause 7 be **removed**. An electrostatic Precipitator (ESP) was installed in 1996 and is otherwise dealt with in Clause 5.

8. Subsequent to setting the ESP into service, the Licencee shall not release particulate matter into the air through the stack from the boiler furnace serving generating Unit 5 in excess of 0.23 grams per standard cubic metre calculated at 25 degrees Celsius and 760 millimetres of mercury corrected to 12 percent carbon dioxide.

Recommendation: Manitoba Hydro recommends that Clause 8 be **revised** to reflect the ongoing operation of the ESP.

> The suggested revised wording is "*The Licencee shall not release particulate matter…"*, where the words *"Subsequent to setting the ESP into service"* have been removed.

Alternatively, the clause could be combined with Clause 5 which also pertains to the operation of the ESP.

9. The Licencee shall mothball generating Units 1, 2, 3, and 4 in the spring of 1996 in their capacity to generate power, and shall not place any of these units back into operation in the generating mode without prior due process under The Environment Act.

Recommendation: Manitoba Hydro recommends that Clause 9 be **revised** to reflect the fact that Units 1, 2, 3 and 4 have been retired and shall not be placed into operation without appropriate regulatory approvals.

> The suggested revised wording is "*The Licencee shall not place* **generating Units 1, 2, 3 or 4** *into operation in the generating mode without prior due process under The Environment Act"*

10. The Licencee shall at all times carry out an efficient program of general housekeeping, equipment maintenance and mitigative measures so as:

(a) to minimize the emission of particulate matter through any of the stacks serving the generating units;

(b) to limit the discharge of fugitive emissions from any source within the plant site such that:

(i) distinct plume forming fugitive emissions do not exceed an opacity of 5%;

(ii) non plume forming fugitive emissions are not at any time visible;

when measured or viewed in the atmosphere at any point beyond the plant site.

Recommendation: Manitoba Hydro recommends that clause 10 be **revised** to reflect that Units 1-4 are retired and that Unit 5 stack now has an ESP installed; therefore, "good housekeeping" on the cyclone pollution control equipment is no longer relevant. Clauses that remain applicable to residual (fugitive) emissions that have the potential to cross the plant boundary should be subject to management programs.

> The suggested revised wording is: "*The Licencee shall carry* **out good management practices to mitigate fugitive emissions.***"*, where the remainder of the clause wording is removed.

In addition, Manitoba Hydro has provided corresponding **revised** wording for the *fugitive emissions* definition in the licence preamble.

11. The Licencee shall, within 24 hours of having received notification from an Environment Officer of a complaint from the public concerning fugitive dust emissions, respond effectively and mitigate the fugitive emissions to the satisfaction of the Director, and submit a report to the Director within seven days outlining why the problem developed, how it was mitigated and what would be done to prevent another similar situation from developing.

Recommendation: Manitoba Hydro recommends that Clause 11 be **retained** with its present wording.

12. The Licencee shall ensure that any downwind point of impingement of plant emissions off the plant site, ground level concentrations of any of the following air pollutants are not in excess of the corresponding limits for any of the listed measurement criteria:

Air Pollutants	*Measurement Criteria*	*Limits*
a) Sulphur Dioxide	*1-hour average* *24-hour average* *annual arithmetic mean measurement*	*900 micrograms per cubic metre* *300 micrograms per cubic metre* *60 micrograms per cubic metre*
b) Nitrogen Dioxide	*1-hour average* *24-hour average* *annual arithmetic mean measurement*	*400 micrograms per cubic metre* *200 micrograms per cubic metre* *100 micrograms per cubic metre*
c) Suspended Particulate Matter	*24-hour average* *annual arithmetic mean measurement*	*120 micrograms per cubic metre* *70 micrograms per cubic metre*

Recommendation: Manitoba Hydro recommends that Clause 12 be **replaced**.

The suggested revised clause wording is "**In the circumstance where ambient air quality monitoring data from within the area of influence of the Brandon G.S. indicates that one or more of Manitoba's Ambient Air Quality Guidelines is being exceeded, or the $PM_{2.5}$ is at levels in excess of 30 µg/m^3 (averaged over a 24-hour period) and the Director is satisfied that Unit 5 is the cause or a significant contributor to the prevailing ambient air quality condition, the Licencee shall undertake such mitigation measures as may be specified by the Director to improve the ambient air quality condition.**"

13. The licencee shall limit sound emissions from all sources on the plant site to the degree that sound levels, when measured off the plant site in any area zoned industrial, do not exceed an $L_{eq}(1)$ of 70 dBA at any time, where the sound level determinations are based on measurements that exclude any

significant interfering sounds from other sources off the plant site, and are based on using a sound level monitoring device which equals or surpasses the requirements of Canadian Standards Association, Standard Z 107.1-1973 (or the equivalent) for Type 2 sound level meters operated on the "A-weighting network" and "slow" meter response.

Recommendation: Manitoba Hydro recommends that Clause 13 be **retained** with its present wording**.**

Respecting Water

14. The licence shall by no later than January 1, 1996:

(a) install and set into full service a closed-loop cooling tower which has the capacity to recirculate at least all steam condenser cooling water requirements associated with generating Unit 5;

(b) report to the Director the findings of the current study being undertaken by the Licencee into the feasibility of cooling all the synchronous condensers and heat exchanger cooling water through the cooling tower, and implement the procedures if determined feasible.

Recommendation: Manitoba Hydro recommends that Clause 14(a) and 14(b) be **removed.** Since February 22, 1996, cooling for the heat exchanger for Unit 5 has been provided by the cooling tower. The report referred to in Clause 14(b) has been submitted and subsequently, Unit 4, which has been operated as a synchronous condenser in the past has been retired along with Units 1-3, and are no longer potential sources of heated effluent.

15. The licencee shall during the transition period from January 1, 1996 to April 1, 1996 maximize recirculation of generating steam condenser and, if determined feasible, synchronous condenser and heat exchanger cooling water through the cooling tower, excluding cooling tower blow-down water, unless a complete tower breakdown occurs.

Recommendation: Manitoba Hydro recommends that Clause 15 be **removed** as the condition applied only to transition period and is no longer relevant.

16. The Licencee shall by no later than April 1, 1996 recirculate all generating Unit 5 steam condenser and, if determined feasible, synchronous condenser and heat exchanger cooling water through the cooling tower, excluding cooling tower blow-down, unless a complete tower breakdown occurs.

Recommendation: Manitoba Hydro recommends that Clause 16 be **revised**. A cooling tower has been installed and operational since February 22, 1996 and Unit 5 can no longer be operated using once-through steam condensing.

The suggested revised wording is: "*The Licencee shall re-circulate all generating Unit 5 steam condenser, synchronous condenser and heat exchanger cooling water through the cooling tower, excluding cooling tower blow-down".*

17. Subject to Clause 18, the Licencee shall, whenever once-through steam condenser cooling water is or must be used for power generation:

(a) avoid power generation during the months of May and June of any year, unless emergency power demand conditions, acknowledged by Director, warrant power generation during these months;

(b) throttle the cooling water intake pumps to minimize the rate of cooling water withdrawl from the Assiniboine River, where emergency power generation has been acknowledged by the Director for May and/or June in any year;

(c) (i) reduce the level of power output at the plant if the temperature of the Assiniboine River intake cooling water is approaching the MWAT value shown in Appendix B for the prevailing month, with the power output reduced to such a level at which the Licencee can demonstrate to the satisfaction of the Director that the heat loading from the cooling water into the Assiniboine River is not causing the downstream mean temperature of the Assiniboine River in the nearest fully mixed zone to exceed the said MWAT value; or

(ii) discontinue power generation at the plant if the temperature of the Assiniboine River intake cooling water is equal to or exceeds the MWAT value shown in Appendix B for the prevailing month; and

unless emergency power demand conditions, acknowledged by the Director, warrant the continuation of the prevailing power generation level, or unless the prevailing flow rate of the Assiniboine River at Brandon is less than the projected 7Q10 flow rate shown in Appendix B for that prevailing month.

Recommendation: Manitoba Hydro recommends that Clause 17 be **removed** because it refers to the former cooling system. A cooling tower has been installed and operational since February 22, 1996 and Unit 5 can no longer be operated using once-through steam condensing.

18. The Licencee shall not release once-through steam condenser cooling water into the Assiniboine River so as to cause the temperature of the river, as measured in the nearest fully mixed zone downstream of the cooling water discharge point, to exceed 30 degrees Celsius , unless emergency power demand conditions, acknowledged by the Director, warrant the continuation of the prevailing power generation level, or unless the prevailing flow rate of the Assiniboine River at Brandon is less than the projected 7Q10 flow rate shown in Appendix B for that prevailing month.

Recommendation: Manitoba Hydro recommends that Clause 18 be **removed** because it refers to the former cooling system. A cooling tower has been installed and operational since February 22, 1996 and Unit 5 can no longer be operated using once-through steam condensing.

19. The Licencee shall, whenever once-through steam condenser cooling water has been used for power generation and power generation shutdown at the plant is contemplated:

(a) Implement all practical measures concerning the gradual reduction of generation and the handling of cooling water flows prior to and during generation shutdowns, with cooling water pumps shut down upon the cessation of generation, so as to minimize the temperature decline rate of the cooling water and the immediate receiving water; and

(b) Ensure that the temperature decline rate of the Assiniboine River in the nearest fully mixed zone does not exceed 6 Celsius degrees per 24 consecutive hours, except subsequent to an emergency shutdown.

Recommendation: Manitoba Hydro recommends that Clause 19 be **removed** because it refers to the former cooling system. A cooling tower has been installed and operational since February 22, 1996 and Unit 5 can no longer be operated using once-through steam condensing.

20. The Licencee shall ensure that at all times all sewage generated on the plant site is directed into the City of Brandon's municipal sewage collection system.

Recommendation: Manitoba Hydro recommends that Clause 20 be **retained** with its present wording.

21. The Licencee shall ensure that the effluent released through either or both of the station drain pipes is of such quality that in any grab sample collected of that effluent either at the discharge points of the station drain pipes near the Assiniboine River or at an equivalent sampling location satisfactory to the Director:

(a) the pH is not less than 6.5 nor greater than 9.5 pH units;

(b) the oil and grease content is not greater than 15 milligrams per litre;

(c) the acid-soluble copper concentration is not greater than 0.5 milligrams per litre.

Recommendation: Manitoba Hydro recommends that the preamble to Clause 21 be **revised** to reflect that although there are two station drain pipes at the discharge point, they drain from a single source and the drain is therefore considered in the singular.

The suggested revised wording is "*The Licencee shall ensure that the effluent released through the station drain is of such quality that…"* , where the words "either or both of… pipes… " have been removed.

Recommendation: Manitoba Hydro recommends that Clauses 21(a), (b) and (c) be **retained** with their present wording.

22. The Licencee shall ensure that the effluent released from the effluent discharge point of the ash lagoon is of such quality that in any grab sample taken of the effluent:

(a) (i) the pH is not less than 6.5 nor greater than 10.0 pH units during the period up to and including the 12 consecutive months following the initial setting into service of the cooling tower;

(ii) the pH is not less than 6.5 nor greater than 9.0 pH units after 12 consecutive months following the initial setting into service of the cooling tower, where the upper pH limit may be subject to review and revision by the Director if the licencee can demonstrate to the satisfaction of the Director that it is impractical to implement this limit of that other compelling environmental disadvantages would ensue by implementing the specified upper limit;

(b) the suspended solids concentration in the effluent is not greater than 25 milligrams per litre in excess of the suspended solids concentration in the raw water of the Assiniboine River sampled on the same day;

(c) *the total chlorine residual concentration is not greater than 0.2 milligrams per litre.*

Recommendation: Manitoba Hydro recommends that Clause 22(a)(i) be **removed** as it deals with the period prior to operation of the cooling tower.

Recommendation: Manitoba Hydro recommends that Clause 22(a)(ii) should be **revised** to reflect that the 12 month period after the in-service of the cooling tower has passed and the pH requirements of the effluent meet Environment Canada's wastewater effluent quality criteria as stated in the *Environmental Codes of Practice for Steam Electric Power Generation - Operations Phase* (Environment Canada, 1992).

The suggested revised wording is "*the pH is not less than 6.5 nor greater than 9.5 pH, where the upper pH limit may be subject to…"*

Recommendation: Manitoba Hydro recommends that Clause 22(b) and (c) be **retained** with their present wording.

23. The Licencee shall install a control observation well, satisfactory to the Director, before September 30, 1994 to facilitate the determination of the background groundwater quality and water table elevation, at a site removed from and unaffected by leachates from the ash lagoon and coal storage pile and up-gradient from the existing observation wells, unless the Licencee can technically demonstrate to the satisfaction of the Director that a control observation well is not practical in this area or that one of the existing observation wells can adequately service the purpose of a control or reference observation well.

Recommendation: Manitoba Hydro recommends that Clause 24 be **removed** as a control well has been installed. The temporary loss of the control well and installation of a new well following the construction of Units 6&7 has been accepted by the Director.

Respecting Solid Waste

24. The Licencee shall deposit all bottom ash and fly ash recovered from the boiler units and the stacks into the ash lagoon, and not remove the ash deposited in the ash lagoon for use or disposal elsewhere without the approval of the Director.

Recommendation: Manitoba Hydro recommends that Clause 25 be **retained** with its present wording.

Monitoring and Reporting Specifications

Respecting Air

25. The Licencee shall notify the Director in writing of:

(a) the completed installation of the ESP;

(b) the completion and results of emission tests carried out on the ESP; and

(c) the date upon which the ESP is set into service.

Recommendation: Manitoba Hydro recommends that this Clause be **removed**. An electrostatic Precipitator was installed in 1996.

26. The Licencee shall:

(a) in each month of each year determine and record:

(i) the maximum instantaneous generated power output (as megawatts);

(ii) the gross monthly generation output (as mega-watt-hours);

(iii) the gross monthly coal and oil consumption (as metric tons and litres, respectively); and

(iv) the gross monthly natural gas consumption (as million cubic metres);

(b) in each month of each year in which the generation mode is active, obtain representative samples of the coal used as the primary fuel at the thermal generating station, and analyze the samples for:

(i) the ash content (% by weight);

(ii) the volatile carbon content (% by weight);

(iii) the fixed carbon content (% by weight);

(iv) the sulphur content (% by weight);

(v) the calorific value (as Joules per kilogram, taken to 2 decimal places);

as determined by means of the most current ASTM method;

(c) in each month of each year in which the generation mode is active, determine:

(i) the monthly average emission rates (as nanograms per Joule of heat input) of sulphur dioxide, nitrogen oxides (expressed as NO_2) and particulate matter emitted from the combined active stacks in that month;

(ii) the total quantities (as metric tons) of greenhouse gases, delineated by the type of gas, emitted from the combined active stacks in that month;

(iii) the total quantities (as metric tons) of greenhouse gases, delineated by the type of gas, emitted from the combined active stacks in that month;

as based on calculations using methods acceptable to the Director;

(d) submit a monthly report on the information determined pursuant to sub-Clauses 26(a), 26(b) and 26(c) to the Director within 30 days of the end of each month; and

(e) submit an annual summary of the information reported pursuant to sub-Clause 26 (d) to the Director by the 1st day of March of each calendar year.

Recommendation: Manitoba Hydro recommends that Clause 26(a) (i), (ii) and (iii) be **retained** with their present wording. It is **recommended** that Clause 26(a) (iv) be removed as natural gas is not used in the operation of Unit 5. Natural gas was only used in the operations of Units 1-4 which have been retired.

Recommendation: Manitoba Hydro recommends that Clause 26(b) and all of the sub-Clauses be **retained** with their present wording.

Recommendation: Manitoba Hydro recommends that Clause 26(c) be **revised** to reflect the use of continuous emissions monitoring of NO_x and SO_2 at the Unit 5 stack.

The suggested revised wording is:

"(c) in each month of each year in which the generation mode is active **monitor and record the air emissions being released through the exhaust duct of the generating unit at such locations as are satisfactory to the Director:**

(i) continuously for the hourly mean emission rate of NO_X (expressed as kilograms of NO_2 per megawatt of heat output);

(ii) **continuously for the 720 hour rolling average of the hourly mean emission rates of NO_X (expressed as kilograms of NO_2 per megawatt-hour of heat output);**

(iii) **continuously for the 720 hour rolling average of the hourly mean emission rates of NO_X (expressed as tonnes of NO_2 per hour);**

(iv) **continuously for the hourly mean emission rate of SO_2 (expressed as kilograms of SO_2 per megawatt of heat output);**

(v) **continuously for the 720 hour rolling average of the hourly mean emission rate of SO_2 (expressed as kilograms of SO_2 per megawatt-hour of heat output); and**

(vi) **continuously for the 720 hour rolling average of the hourly mean emission rate of SO_2 (expressed as tonnes of SO_2 per hour);"**

Recommendation: Manitoba Hydro recommends that five new clauses related to monitoring data from the CEMS be **inserted** following Clause 26(c). These clauses would be inserted as 26(d) to (h). A sixth new clause, 26 (i), would specify CEM-related data reporting requirements. The existing Clauses 26 (d) and (e) would be **retained** with their present wording, becoming 26 (j) and (k); the reference within 26 (j) should no longer refer to 26 (c) as this is now covered in clause 26 (i); 26(k) should be corrected to read "… *pursuant to sub-Clause 26(**j**)…"*.

The suggested new clauses would read:

"(d) ensure that if the total valid data recorded by a certified CEM system on any day of operation of the boiler burners for Unit 5 accounts for less than 100% of the operational time of the unit, that the missing data for the balance of the operating time is backfilled in accordance with Environment Canada report EPS 1/PG/7 or such alternate manner as is acceptable to the Director;

(e) ensure that if the total recorded valid data in any month of any year by a certified CEM system accounts for less than 80% of the total operational time of Unit 5, the Director is notified of the situation, the source of the problem and the proposed course of action to remedy the situation;

(f) retain all of the electronic and backfilled monitoring data generated pursuant to sub-Clauses 23(c) and 23(d) of this Licence in electronic form for a minimum of seven years;

(g) submit to the Director such electronic monitoring data or hard copy information on the data compiled and recorded pursuant to sub-Clause 23(f) of this Licence, if and when requested by the Director;

(h) submit a monthly report to the Director within 30 days of the end of each month, consisting of the monthly mass emissions of greenhouse gases and PM (each expressed in units most appropriate to their respective magnitudes) released to the atmosphere through the generating unit's exhaust duct. The emission rate factors for those

parameters not being continuously monitored pursuant to this Licence may be sourced from the US EPA Document AP-42, determined as per Environment Canada's Environmental Protection Series 1993 report EPS 1/PG/7, determined through actual on-site exhaust duct sampling, or such alternate manner that is acceptable to the Director;

(i) regarding the information pursuant to sub-Clauses 26(c) (i) through 26(c) (vi), submit a monthly report to the Director within 30 days of the end of each month, consisting of:

(i) the percent of time on each day:

- **the CEM system was fully functioning; and**
- **valid data was recorded for each continuously monitored parameter;**

(ii) the daily peak 720 hour rolling average hourly mean emission rates of SO_2 and NO_x in tonnes/hour and kg/megawatt-hour;

(iii) the daily total mass emissions of NO_x, SO_2, and total VOCs (each expressed in units most appropriate to their respective magnitudes) released to the atmosphere through the generating unit's exhaust duct. The emission rate factors for those parameters not being continuously monitored pursuant to this Licence may be sourced from the US EPA Document AP-42, determined as per Environment Canada's Environmental Protection Series 1993 report EPS 1/PG/7, determined through actual on-site exhaust duct sampling, or such alternate manner that is acceptable to the Director;

(iv) the number of hours in which the emission rates exceeded the approved emission limits defined in Clause 6; and

(v) the total daily and total monthly mass emissions of such other elements and compounds released to the atmosphere through the generating unit's exhaust duct, as may be requested by the Director."

27. The Licencee shall, at such times, for such duration, for such pollutants and at such locations as may be requested by the Director:

(a) undertake source emission tests, and/or special studies to determine the ambient air quality in the vicinity of the plant site, in a manner satisfactory to the Director, including an interpretation of the results relative to the limits of Clauses 6, 8 and/or 12; and;

(b) submit a report on the source emission test results and/or the ambient air quality data, and all other related data, including the interpretation, to the Director within 90 days after completion of the studies.

Recommendation: Manitoba Hydro recommends that Clause 27 should be **retained** with its present wording.

28. The Licencee shall, at such times, for such duration and at such locations as may be requested by the Director:

(a) carry out sound level surveys, in a manner satisfactory to the Director, including an interpretation relative to the limits of Clause 13; and;

(b) submit the results of the survey, including the interpretation, to the Director within 30 days following the completion of the specified survey.

Recommendation: Manitoba Hydro recommends that Clause 28 should be **retained** with its present wording.

29. The Licencee shall complete a risk assessment study on the occupational health risk associated with airborne asbestos fibres arising from asbestos containing materials present at this plant, and report the findings of this study to the Director no later than October 31, 1994.

Recommendation: Manitoba Hydro recommends that Clause 29 should be **removed** as it pertains to a report that has been submitted.

Respecting Water

30. The Licencee shall in each month of each year:

(a) determine and record the total monthly quantity of water (as cubic metres) withdrawn from the Assiniboine River;

(b) during those periods when the plant is operating in the power generating mode:

(i) determine and record the daily total water (as cubic metres) and the peak water withdrawal rate (as cubic metres per second) withdrawn from the Assiniboine River through the cooling water intakes, when applicable;

(ii) determine and record the daily total water (as cubic metres) and the peak water withdrawal rate (as cubic metres per second) withdrawn from the Assiniboine River through the raw water intakes;

(iii) determine and record the daily average temperature of the once-through cooling water withdrawn from the Assiniboine River, when applicable; and

(iv) record which generating unit(s) were operated in the power generating mode and which of these units were cooled with once-through steam condenser cooling water;

whereby the water withdrawal quantities are determined by a method of measurement of estimation satisfactory to the Director; and

(c) submit the information recorded pursuant to sub-Clauses 30(a) and 30(b) to the Director within 30 days of the end of the month during which the information was collected.

Recommendation: Manitoba Hydro recommends that Clause 30(a) be **retained** with its present wording.

Recommendation: Clauses 30(b)(i), 30(b)(iii) and 30(b)(iv) should be **removed** because they refer to the former cooling system. A cooling tower has been installed and operational since February 22, 1996 and Unit 5 can no longer be operated using once-through steam condensing. Manitoba Hydro recommends that Clause 30(b)(ii) be **retained** with its present wording except for the reference to the raw water intakes which should be **revised** to be singular.

Recommendation: Manitoba Hydro recommends that Clause 30(c) be **retained** with its present wording.

31. The Licencee shall:

(a) undertake a sampling program, in consultation with Manitoba Natural Resources and Fisheries and Oceans, to collect, identify and measure the size of fish impinged on the travelling screens associated with:

(i) the mid-channel raw water intake line; and

(ii) the side-channel cooling water intake lines, during once-through cooling water withdrawals; and

(b) provide the Director by the 1st day of September of each year after 1993 with a monthly summary of the information complied through sub-Clause 31(a) in the preceding 12 months ending on the 31st day of July in that reporting year, together with an assessment of the relationship between water withdrawal (i.e. volume per 24 hours, flow rate and intake velocity) and the entrainment and impingement of fish;

until the Director is satisfied that sufficient data has been collected to determine whether or not improvements to the intake and/or fish designs are warranted.

Recommendation: Manitoba Hydro recommends that Clause 31 be **removed** as a raw water intake screen has been installed since 2002.

32. The Licencee shall, during periods whenever power is generated at the plant with the use of once-through steam condenser cooling water:

(a) continuously monitor the temperature and the temperature decline rate over time (in Celsius degrees per hour) of the cooling water released through the outfall of the cooling water discharge pipe, and keep the continuously recorded data charts for at least one year for possible inspection or submission to the Director;

(b) monitor the temperature of the Assiniboine River in the fully mixed zone of the river downstream of the cooling water discharge point, to ensure compliance with the temperature limits of Clauses 17, 18 and 19;

(c) report each emergency shutdown of the power generating units to the Director, by facsimile, within 8 hours of its occurrence; and

(d) submit a report to the Director, within 30 days of each month during which power generation

occurred, identifying:

(i) the daily maximum measured temperature of the discharged cooling water;

(ii) the shutdown date(s) of the power generation unit(s);

(iii) whether the shutdowns were emergency or normal shutdowns;

(iv) the maximum recorded cooling water temperature decline rate (in Celsius degrees per hour and Celsius degrees per 24 consecutive hours) associated with each shutdown event; and

(v) the daily maximum temperature measured in the fully mixed zone of the Assiniboine River.

Recommendation: Manitoba Hydro recommends that Clause 32 be **removed** because it refers to the former cooling system. A cooling tower has been installed and operational since February 22, 1996 and Unit 5 can no longer be operated using once-through steam condensing.

33. The Licencee shall notify the Director in writing of the date on which the cooling tower is set into service.

Recommendation: Manitoba Hydro recommends that Clause 33 be **removed** as notification has been provided.

34. The Licencee shall:

(a) determine and record the total quantities of effluent (as cubic metres) discharged each month from:

(i) the cooling water discharge pipe;

(ii) the station drain pipes; and

(iii) the ash lagoon discharge point;

where such determinations are based on methods of measurement or estimation satisfaction to the Director; and

(b) report this information to the Director within 30 days of the end of the month during which the information was determined.

Recommendation: Manitoba Hydro recommends that Clause 34(a)(i) be **removed** because it refers to the former cooling system. A cooling tower has been installed and operational since February 22, 1996 Unit 5 can no longer be operated using once-through steam condensing. Clause 34(a)(ii) should be **revised** to reflect that there is only one station drain, as per the suggested revised wording for Clause 21. Manitoba Hydro recommends that Clause 34(a)(iii) be **retained** with its present wording.

Recommendation: Manitoba Hydro recommends that Clause 34(b) be **retained** with its present wording.

35. The Licencee shall, during effluent discharge events from the station drain pipes and/or the cooling water discharge pipe:

(a) collect a grab sample of effluent once each week, from each station drain outfall near the Assiniboine River or at an equivalent sampling location satisfactory to the Director, and analyze each sample for:

(i) pH (pH units);

(ii) total dissolved solids (milligrams per litre);

(iii) hardness (as $CaCO_3$) (milligrams per litre);

(iv) sulphates (as SO_4) (milligrams per litre);

(v) total phosphorous (milligrams per litre);

(vi) soluble boron (milligrams per litre);

(vii) total iron (milligrams per litre); and

(viii) acid-soluble copper (milligrams per litre);

and,

(b) collect a grab sample of effluent once each week, at the cooling water outfall, as well as from each station drain outfall near the Assiniboine River or at an equivalent sampling location satisfactory to the Director, and analyze each grab sample for oil and grease (milligrams per litre)

Recommendation: Manitoba Hydro recommends that the preamble be **revised** to reflect one station drain and to remove references to cooling water discharge to reflect the use of a cooling tower since 1996.

The suggested revised preamble should read: "*The Licencee shall, during effluent discharge from the station drain outfall:"*

Recommendation: Manitoba Hydro recommends that Clause 35(a) be **revised** to reflect one station drain pipe.

The suggested revised wording is "*collect a grab sample of effluent once each week, from* **<u>the</u>** *station drain outfall or an equivalent sampling location…"*

Recommendation: Manitoba Hydro recommends that Clause 35(b) be **revised** to refer to a single station drain, and remove the reference to the cooling water outfall because this refers to the former cooling system. A cooling tower has been installed and operational since February 22, 1996.

The suggested revised wording is "*collect a grab sample of effluent once each week from* **<u>the</u>** *station drain outfall near the Assiniboine River or at an equivalent sampling location satisfactory to the Director, and analyze each grab sample for…"*

36. The Licencee shall report the weekly data determined pursuant to sub-Clause 35(a) and 35(b), along with the monthly averages, to the Director within 30 days of the end of the month in which the samples were collected.

Recommendation: Manitoba Hydro recommends that Clause 36 be **removed** as a separate clause**,** but **retained** with its present wording and placed into Clause 35 above as a new subsection 35(c), as it pertains directly to Clause 35 and only Clause 35.

37. The Licencee shall, during discharge events from the ash lagoon:

(a) collect a grab sample of effluent once each week at the discharge point of the ash lagoon, and analyze each sample for:

(i) pH (pH units);

(ii) total dissolved solids (milligrams per litre);

(iii) suspended solids (milligrams per litre);

(iv) hardness (as $CaCO_3$) (milligrams per litre);

(v) sulphates (SO_4) (milligrams per litre);

(vi) total phosphorous (milligrams per litre);

(vii) total iron (milligrams per litre); and

(viii) total chlorine residual (milligrams per litre);

(b) collected a grab sample of effluent once every two weeks at the discharge point of the ash lagoon, and analyze each sample for the following trace elements:

(i) soluble boron (milligrams per litre);

(ii) acid-soluble arsenic (milligrams per litre);

(iii) acid-soluble copper (milligrams per litre);

(iv) acid-soluble lead (milligrams per litre);

(v) total zinc (milligrams per litre);

(vi) acid-soluble cadmium (milligrams per litre); and

(vii) total selenium;

(c) collect a grab sample of raw river water at the plant's raw water pumphouse on each day on which the ash lagoon effluent is sampled for suspended solids, and analyze each sample for suspended solids (milligrams per litre); and

(d) collect a grab sample of raw river water at the plant's raw water pumphouse once every month and analyze each sample for all the parameters listed in sub-Clauses 37(a) and 37(b);

unless otherwise specified by the Director.

Recommendation: Manitoba Hydro recommends that the preamble to Clause 37 be **revised** to remove the word "events" which is redundant.

Recommendation: Manitoba Hydro recommends that Clause 37(a) and (b) be **retained** with their present wording.

Recommendation: Manitoba Hydro recommends that Clause 37(c) and (d) be **revised** accurately identify the sampling location.

> The suggested revised wording is "*collect a grab sample of raw river water* **near** *the plant's raw water pumphouse…"*

38. The Licencee shall:

(a) report the data determined pursuant to sub-Clauses 37(a), 37(b), 37(c) and 37(d), along with monthly averages where applicable, to the Director within 30 days of the end of the month in which the samples were collected; and

(b) submit an annual report by the 31st day of July of each year for up to three years following the year in which the ESP and the cooling tower were put into service, which summarizes the degree of any changes observed in the water chemistry from the ash lagoon, and interprets the associated environmental significance relative to the Manitoba Surface Water Quality Objectives.

Recommendation: Manitoba Hydro recommends that Clause 38(a) be **removed** as a separate clause**,** but **retained** with **revised** wording and placed into Clause 37 above as a new subsection 37(f), as it pertains directly to Clause 37.

Recommendation: Manitoba Hydro recommends that Clause 38(b) be **removed**. The ESP and the cooling tower have been in operation since 1996 and the three-year reporting period has expired.

39. The Licencee shall carry out a leachate test, in accordance with the methods described in Schedule "B" of Manitoba Regulation 282/87 issued under the Dangerous Goods Handling and Transportation Act, on a representative sample of the coal stored on or used at the plant site, in order to characterize the potential worst case chemical quality, dissolved trace element content and dissolved organic constituents of such leachate waters, and submit a report on the findings and their interpretations to the Director by December 31, 1993. The results of a similar leachate test required on the same source of coal under Environmental Act Licence No. 1645 may be used to satisfy the requirement of the Clause.

Recommendation: Manitoba Hydro recommends that Clause 39 be **removed** as the report has been submitted.

40. The Licencee shall:

(a) monitor the quality of the surface runoff from the plant site at the surface runoff discharge points shown in Appendix A, under surface water runoff conditions throughout the year, at sufficient frequency to produce a statistical profile of the quality of the surface runoff at each surface runoff discharge point with respect to pollutants which could potentially be transported from the plant site; and

submit a report to the Director, by the 1st day of February of each year, on the data complied in the preceding calendar year;
until the Director is satisfied that sufficient representative data has been acquired to characterize the quality of these periodic releases to the Assiniboine River.

Recommendation: Manitoba Hydro recommends that Clause 40(a) be **removed** as monitoring has been completed and Manitoba Conservation approved the termination surface run-off water quality monitoring (March 26, 1996).

Recommendation: Manitoba Hydro recommends that this Clause 40(b) be **removed** as the report has been submitted.

41. The Licencee shall:

(a) once every month, monitor the 12 groundwater observation wells around the ash lagoon and the coal pile as shown in Appendix A, as well as any additional control or reference observation well, for their water table elevations and the chemical parameters being analyzed to date, as listed Appendix B.2 of Volume 11 of the Licencee's Environmental Impact Assessment dated August 1992; and

(b) conduct a study integrating the data determined pursuant to sub-Clause 41(a) on the control ash lagoon and coal pile observation wells to determine magnitude of pollutants in the groundwater and the direction of movement of the pollutants in the groundwater; and

(c) submit an annual report to the Director by the 1st day of February of each year on the data collected pursuant to the sub-Clause 41(a), together with an interpretation of the findings of the study carried out pursuant to sub-Clause 41(b);

until the Director is satisfied that the monitoring frequency of sub-Clause 41(a) can be decreased and that the studies specified under sub-Clause 41(b) can be terminated.

Recommendation: Manitoba Hydro recommends that Clause 41(a) be **revised** to reflect the approved changes to quarterly monitoring and parameter list as indicated in a letter from Manitoba Conservation (March 1997). It should also indicate that metal concentrations are analyzed for dissolved components rather than total amounts of listed parameters.

The suggested revised wording is "**quarterly**, *monitor the 12 groundwater observation wells around the ash lagoon and the coal stockpile as shown in Appendix A, as well as any additional control or reference observation well, for their water table elevations and the chemical parameters being analyzed to date; and*"

Recommendation: Manitoba Hydro recommends that this Clause 41(b) be **removed** as the report has been submitted.

Recommendation: Manitoba Hydro recommends that this Clause 41(c) be **revised** to specify a reporting data of March 31 to better reflect station reporting cycles. The reference to Clause 41(b) should be removed as the study has been submitted.

The suggested revised wording is "*submit an annual report to the Director by the* **31st day of March** *of each year on the data collected pursuant to the sub-Clause 41(a);"*

42. At least one year in advance of the projected date for commencing the decommissioning of the power generating station, the Licencee shall submit to the Director, for approval, a detailed Closure Plan outlining the measures proposed to address environmental and health issues which might arise in the course of, and subsequent to, the decommissioning of the said station, and implement the approved Closure Plan in accordance with a time frame satisfactory to the Director.

Recommendation: Manitoba Hydro recommends that Clause 42 be **retained** with its present wording.

9.2.5 REVIEW AND REVOCATION

Respecting Review and Revocation

43. This Licence replaces the Environment Act Licence No. 1246 which is hereby rescinded.

Recommendation: Manitoba Hydro recommends that Clause 43 be **revised** to reflect reference to the operating licence resulting from this Licence Review process.

44. This Licence shall be reviewed by the Director if the plant is not retired as a thermal generating station in or before the year 2006, or if in the opinion of the Director the operational pattern of the plant has altered from the expected normal operating projections stated in the Licencee's 1992 Environmental Impact Assessment, or if any studies or monitoring programs undertaken pursuant to this Licence or otherwise, give rise to new evidence to warrant a change to this Licence.

Recommendation: Manitoba Hydro recommends that Clause 44 be **revised** to reflect the updated Licence agreement and that the Unit will not be retired before 2006. In addition, it is recommended that the clause be further revised to establish that the measure of regulatory compliance be only the specific terms and conditions of the licence and no longer refer directly to external documents for the purposes of evaluating compliance.

The suggested revised wording is "*This Licence shall be reviewed by the Director if in the opinion of the Director the* **operation of Unit 5 is not occurring in accordance with the terms and conditions of this licence, or** *if any studies or monitoring programs undertaken pursuant to this Licence or otherwise, give rise to new evidence to warrant a change to this Licence."*

45. If in the opinion of the Director the Licencee has failed or is failing to comply with any of the specifications, limits, terms or conditions set out herein, the Director may, temporarily or permanently, revoke this Licence.

Recommendation: Manitoba Hydro recommends that Clause 45 be **retained** with its present wording.

9.2.6 APPENDICES

The map comprising **Appendix A** of the Licence should be replaced with the Drawing labelled Figure 2-2 in this report in order to have an up-to-date site plan.

It is recommended that **Appendix B** be removed as it refers to the former cooling system. A cooling tower has been installed and operational since February 22, 1996 and is used for the heat exchanger and Unit 5 can no longer be operated using once-through steam condensing.

CHAPTER 10

REFERENCES

10.0 REFERENCES

10.1 LITERATURE CITED

BEZENER, ANDY AND KEN DE SMET. 2000. Lone Pine Field Guide: Manitoba Birds. Lone Pine Publishing, Edmonton, AB.

BRUEDERLIN, B. 1993. Assiniboine River creel census and economic survey - 1993. Manitoba Department of Natural Resources, Fisheries Branch. Unpublished Report.

CANADIAN COUNCIL OF RESOURCE AND ENVIRONMENT MINISTERS (CCME). 1987. Canadian Water Quality Guidelines.

COOLEY, M., F. SCHNEIDER-VIEIRA, and A. KIERS NORTH. 2003. Assiniboine River monitoring study water quality component: Water quality assessment and model for the open-water season, 2002, May 2003. A study conducted for the City of Brandon by Earth Tech Canada Inc. and North/South Consultants Inc.

ENVIRONMENT CANADA. 1986. Environmental codes of practice for steam electric power generation – design phase. Report EPS 1 /PG/1.

ENVIRONMENT CANADA. 2006. Species at Risk. http://www.speciesatrisk.gc.ca/

GLENN, C.L., and R. R. G. WILLIAMS. 1976. Fecundity of mooneye, Hiodon tergisus, in the Assiniboine River. Can. J. Zool. 54:156-161.

GOLDER ASSOCIATES LTD. 2001. The assessment of potential impacts to fish habitat associated with proposed upgrading and repairs to the Manitoba Hydro water intake structure on the Assiniboine River at Brandon, Manitoba. A report prepared for Manitoba Hydro by Golder Associates Ltd., November 2001, 10 pp. + appendices.

GOLDER ASSOCIATES LTD. 2003a. Fish screen effectiveness monitoring for Manitoba Hydro's water intake structure on the Assiniboine River at Brandon, Manitoba. A report prepared for Manitoba Hydro by Golder Associates Ltd., January 2003, 31 pp. + appendices.

GOLDER ASSOCIATES LTD. 2003b. Fish screen effectiveness monitoring for Manitoba Hydro's water intake structure on the Assiniboine River at Brandon, Manitoba, 2003 Monitoring Activities. A report prepared for Manitoba Hydro by Golder Associates Ltd., December 2003, 10 pp. + appendices.

HUGHES, C.E., M.L. HUGHES, and D.A. WILLIAMSON. 1992. Effects of effluent from a thermal-electric generating station on the Assiniboine River at Brandon, Manitoba , Canada. Water Quality Management Section Report #92-3. Manitoba Department of Environment.

JOHNSON, DEREK, LINDA KERSHAW, ANDY MACKINNON AND JIM POLAR. 1995. Lone Pine Field Guide: Plants of the Western Boreal Forest and Aspen Parkland. Lone Pine Publishing, Edmonton, AB.

KURTA, ALLEN. 2001. Mammals of the Great Lake Region. University of Michigan Press, Ann Arbor, MI.

LAWRENCE, M., and W. BERNHARDT. 1998. Assessment of the effects of the Maple Leaf Waste Water Treatment Facility effluent on the Assiniboine River. A report prepared for the City of Brandon by North/South Consultants Inc. and Reid Crowther and Partners Ltd. June 1998. 70 pp + i. appendices.

MANITOBA CONSERVATION. 2006. Species at Risk: Aspen Parkland – Species Information. http://web2.gov.mb.ca/conservation/cdc/species/ecoregions/aspenpkld.php

McCULLOCH, B. R., and W. G. FRANZIN. 1996. Fishes of the Canadian portion of the Assiniboine River drainage. Can. Tech. Fish. Aquat. Sci. 2087: v + 62 p.

NELSON, P.A., and W.G. FRANZIN. 2000. Habitat availability and its utilization by 11 species of fish from the Assiniboine River, Manitoba with special reference to habitat processes. Can. Tech. Rep. Fish. Aquat. Sci. 2313: vi + 55p.

SCHNEIDER-VIEIRA, F., M. COOLEY, A. KIERS NORTH, and E. SHIPLEY. 2003. Industrial wastewater treatment facility expansion: water quality assessment, May 2003. A study conducted for the City of Brandon by Earth Tech Canada Inc. and North/South Consultants Inc.

SENES. 1992. Environmental Impact Assessment: Thermal Life assurance Program, Brandon Generating Station. Volume 1: Summary and Main Report (August 1992); Volume 2: Appendices A - Z (August 1992); Volume 3: Addendum (January 1993). A report prepared for Manitoba Hydro by SENES Consultants Ltd., Winnipeg, MB.

SENES. 2001. Selkirk Generating Station Fuel Switching Project. Appendix B: Air Quality Impact Assessment Gas Conversion Project. Prepared for Manitoba Hydro, Winnipeg, MB.

SENES. 2005. Selkirk Generating Station Licence Review. Appendix E: Air Quality Impact Assessment. Prepared for Manitoba Hydro, Winnipeg, MB.

SMITH, R.E., H. VELDHUIS, G.F. MILLS, R.G. EILERS, W.R. FRASER, and G.W. LELYK. 1998. Terrestrial Ecozones, Ecoregions, and Ecodistricts, An Ecological Stratification of Manitoba's Natural Landscapes. Technical Bulletin 98-9E. Land Resource Unit, Brandon Research Centre, Research Branch, Agriculture and Agri-Food Canada, Winnipeg, Manitoba.

STEWART, K.W., B. R. McCULLOCH, and J.D. TYSON. 1990. Heating effects on several fish species overwintering in a thermal plume downstream of Manitoba Hydro's Brandon thermal generating station. University of Manitoba, Department of Zoology. 21 p. Unpublished Report.

STEWART, K.W. and D. A. WATKINSON. 2004. The freshwater fishes of Manitoba. University of Manitoba Press, Winnipeg, Manitoba, 276 p.

TOEWS, J and F. SCHNEIDER-VIEIRA. 1999. A fish habitat assessment of the Assiniboine River near Brandon. A report prepared for the City of Brandon by Reid Crowther & Partners & North/South Consultants Inc. 48 pp.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (USEPA). 2004. Draft aquatic life water quality criteria for selenium - 2004. Office of Water, Office of Science and Technology, USEPA, Washington, DC. EPA-822-D-04-001.

WILLIAMSON, D. 2002. Manitoba water quality standards, objectives, and guidelines. Manitoba Conservation Report 2002-11. Water Quality Management Section, Water Branch, Manitoba Conservation. Final Draft: 22 November 2002.