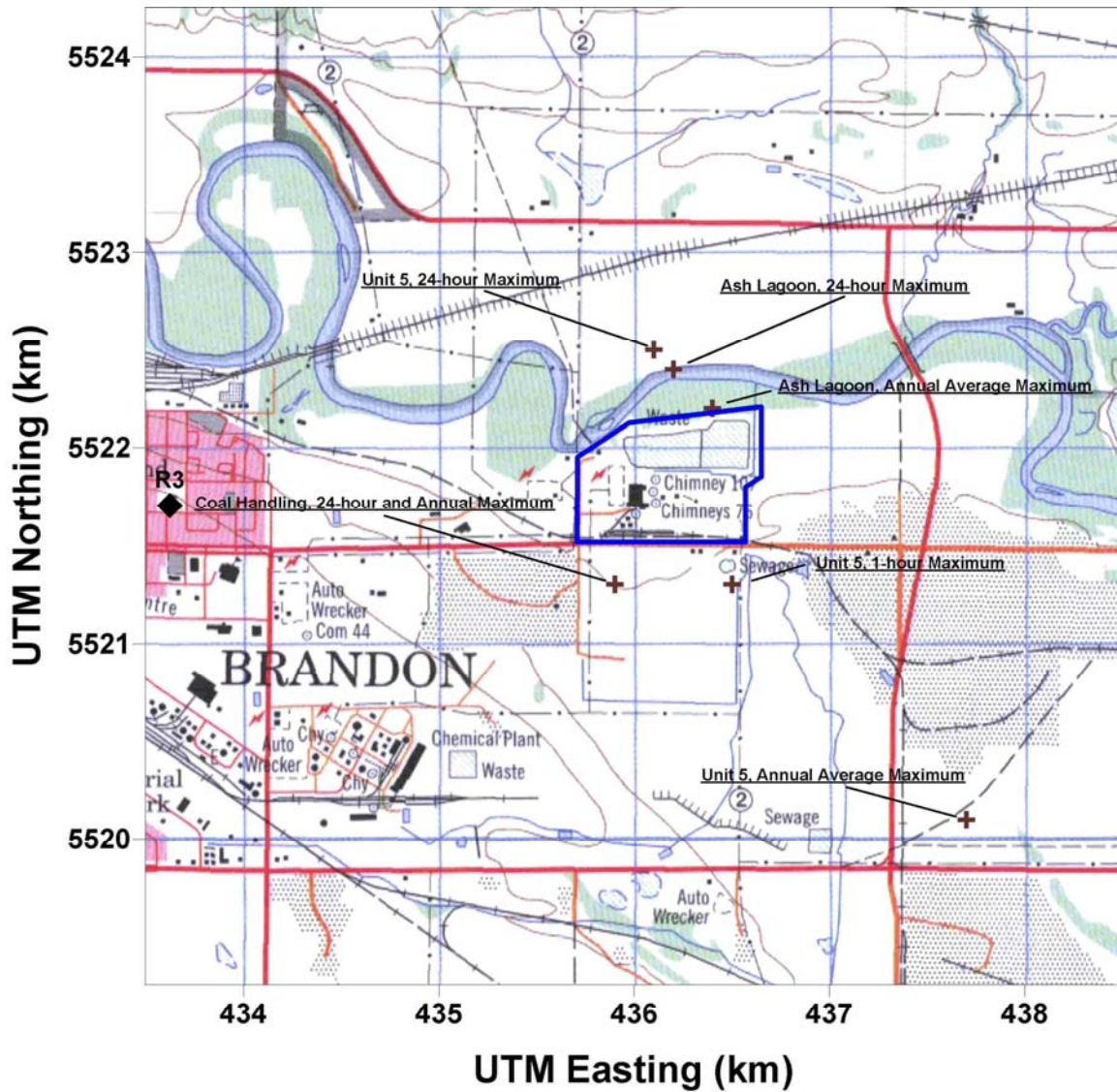**Figure 5.1**

**Locations of Maximum Predicted Point of Impingement (POI) Pollutant Concentrations
Due to Unit #5 and Fugitive Dust Emissions**

Predicted incremental ground-level air concentrations of all Contaminants of Potential Concern (COPC) are listed in Table 5.3. For COPCs with applicable short-term guidelines or objectives (as listed in Tables 5.1 and 5.2), the predicted short-term concentrations are also shown. The short-term maximum concentrations are predicted to occur very near the Brandon G.S., while the annual average concentrations occur at a greater distance. Table 5.4 provides a comparison of maximum COPC concentrations with applicable guidelines or objectives. Further discussion of the predicted common air contaminant (CAC), volatile organic compound (VOC), trace inorganic (i.e., metals) and trace inorganic concentrations is provided in the following sections.

Table 5.3
Maximum Ground-level Concentrations at Maximum Point of Impingement
(Operating Scenario OS2)

Contaminants of Potential Concern	Averaging Period			
	1-hour	8-hour	24-hour	Annual
Common Pollutants				
PM$_{2.5}$ (also PM$_{10}$ and SPM)			0.5	1.74E-02
CO	19.1	4.2	1.4	
NO$_2$ (100% NO conversion)	321.6		23.6	8.65E-01
SO$_2$	199.6		14.6	5.37E-01
HF			0.013	
HCl	0.19			
Volatile Organics				
Acetaldehyde			9.65E-04	3.54E-05
Acetophenone				9.31E-07
Acrolien			4.91E-04	1.80E-05
Benzene	3.00E-02		2.20E-03	8.07E-05
Benzyl chloride				4.35E-05
Bis(2-ethylhexyl)phthalate (DEHP)				4.53E-06
Bromoform				2.42E-06
Carbon disulphide				8.07E-06
2-Chloroacetophenone				4.35E-07
Chlorobenzene				1.37E-06
Chloroform				3.66E-06
Cumene				3.29E-07
Cyanide				1.55E-04
2,4-Dinitrotoluene				1.74E-08
Dimethyl Sulphate				2.98E-06
Ethyl benzene				5.84E-06
Ethyl chloride				2.61E-06
Ethylene dichloride				2.48E-06
Ethylene dibromide				7.45E-08
Formaldehyde	5.54E-03			1.49E-05
Hexane				4.16E-06
Isophorone				3.60E-05

Contaminants of Potential Concern	Averaging Period			
	1-hour	8-hour	24-hour	Annual
Methylbromide				9.93E-06
Methyl chloride				3.29E-05
Methyl ethyl ketone				2.42E-05
Methyl hydrazine				1.06E-05
Methyl methacrylate				1.24E-06
Methyl tert-butyl ether				2.17E-06
Methylene chloride				1.80E-05
Phenol			2.71E-05	9.93E-07
Propionaldehyde				2.36E-05
Tetrachloroethylene				2.67E-06
Toluene			4.06E-04	1.49E-05
1,1,1-Trichloroethane				1.24E-06
Styrene			4.23E-05	1.55E-06
Xylenes			6.26E-05	2.30E-06
Vinyl acetate				4.72E-07
Trace Inorganics				
Aluminium				2.23E-03
Antimony			1.07E-05	3.90E-07
Arsenic			9.47E-05	3.47E-06
Barium			2.85E-02	1.04E-03
Beryllium			4.68E-06	1.71E-07
Boron			2.61E-03	9.54E-05
Cadmium			7.70E-06	2.82E-07
Chromium	1.70E-03		1.24E-04	4.55E-06
Cobalt			1.89E-05	6.93E-07
Copper			3.02E-04	1.11E-05
Iron				8.23E-04
Lithium			4.97E-04	1.82E-05
Manganese			3.32E-04	1.21E-05
Mercury			1.47E-04	4.70E-06
Molybdenum			1.12E-04	4.12E-06
Nickel			8.29E-05	3.03E-06
Palladium				2.60E-06
Lead			8.29E-05	3.03E-06
Selenium			7.70E-05	2.82E-06
Silver			5.03E-06	1.84E-07
Strontium			5.80E-03	2.12E-04
Thallium				3.90E-07
Thorium				9.54E-07
Tin			1.18E-04	4.33E-06
Uranium				4.33E-07
Vanadium			1.84E-04	6.72E-06
Zinc			7.70E-05	2.82E-06
Trace Organics (PAHs)				
Acenaphthene				3.12E-07

Contaminants of Potential Concern	Averaging Period			
	1-hour	8-hour	24-hour	Annual
Acenaphthylene				2.17E-09
Anthracene				1.37E-08
Benzo(a)anthracene				1.95E-09
Benzo(b)anthracene				3.25E-09
Benzo(b)fluoranthene				3.03E-09
Benzo(k,j)fluoranthene				3.68E-09
Benzo(a)flourene				4.77E-09
Benzo(b)flourene				1.08E-09
Benzo(g,h,i)perylene				8.67E-09
Benzo(a)pyrene				2.82E-09
Benzo(e)pyrene				1.26E-08
Biphenyl				1.47E-07
2-chloronaphthalene				4.55E-10
Coronene				5.20E-09
Dibenzo(a,c & a,h)anthracene				1.58E-10
Dibenzo(a,j)acridine				7.80E-11
7H-dibenzo(c,g)carbazole				1.21E-10
Dibenzo(a,e)pyrene				2.17E-11
Dibenzo(a,i)pyrene				2.82E-11
9,10-dimethylanthracene				1.19E-09
7,12-dimethylanthracene				3.68E-10
1,2-dimethylnaphthalene				1.84E-09
2,6 & 2,7-dimethylnaphthalene				7.15E-09
Fluoranthene				3.68E-08
Fluorene				4.33E-08
Indeno(1,2,3-cd)pyrene				1.50E-09
2-methylanthracene				2.38E-09
3-methylcholanthrene				6.50E-09
1-methylnaphthalene				4.33E-08
2-methylnaphthalene				6.50E-08
1-methylphenanthrene				1.80E-08
9-methylphenanthrene				1.60E-08
Naphthalene			3.55E-06	1.30E-07
Perylene				8.89E-10
Phenanthrene				2.38E-07
Picene				1.45E-10
Pyrene				2.38E-08
Quinoline				1.80E-09
m-Terphenyl				6.28E-09
o-Terphenyl				9.97E-09
p-Terphenyl				3.25E-09
Tetralin				1.41E-08
Triphenylene/chrysene				8.23E-09
Dioxins/Furans				
Tetrachlorodibenzo-p-dioxins				1.07E-13

Contaminants of Potential Concern	Averaging Period			
	1-hour	8-hour	24-hour	Annual
Pentachlorodibenzo-p-dioxins				8.41E-14
Hexachlorodibenzo-p-dioxins				4.67E-12
Heptachlorodibenzo-p-dioxins				1.25E-11
Octachlorodibenzo-p-dioxins				1.75E-11
Total Dioxins				3.02E-11
Tetrachlorodibenzofurans				1.98E-11
Pentachlorodibenzofurans				1.81E-11
Hexachlorodibenzofurans				6.65E-12
Heptachlorodibenzofurans				3.67E-12
Octachlorodibenzofurans				7.88E-11
Total Furans				2.68E-12

Table 5.4a
Maximum Predicted Incremental Concentrations (µg/m³) of CACs
Due to Unit #5 Emissions with Relevant Ambient Air Quality Criteria in Manitoba

Contaminant	Criterion Classification	Averaging Period	Criterion Value	Operational Scenario	Maximum Predicted Ground-level Concentration	Percent of Applicable Criterion[4]
NO$_2$[1] Janssen Method	Objective	1-hour 24-hour annual	400 200 100	OS1	91.0 7.9 0.2	22.8% 4.0% 0.2%
NO$_2$[1] Janssen Method	Objective	1-hour 24-hour annual	400 200 100	OS2	119.0 10.4 0.2	29.8% 5.2% 0.2%
NO$_2$[2] 100% Conversion	Objective	1-hour 24-hour annual	400 200 100	OS1	243.0 17.8 0.6	60.8% 8.9% 0.6%
NO$_2$[2] 100% Conversion	Objective	1-hour 24-hour annual	400 200 100	OS2	322.0 23.6 0.9	80.5% 11.8% 0.9%
CO	Objective	1-hour 8-hour	35,000 15,000	OS1	16.1 3.5	0.05% 0.02%
CO	Objective	1-hour 8-hour	35,000 15,000	OS2	19.1 4.2	0.1% 0.03%
SO$_2$	Objective	1-hour 24-hour annual	900 300 60	OS1	190.0 13.9 0.51	21.1% 4.6% 0.85%
SO$_2$	Objective	1-hour 24-hour annual	900 300 60	OS2	200.0 14.6 0.54	22.2% 4.9% 0.8%
SO$_2$	Objective	1-hour 24-hour annual	900 300 60	OS3	265.5 19.5 0.71	29.5% 6.5% 1.2%
PM$_{10}$	Guideline	24-hour	50	OS1	0.5	1.%
PM$_{10}$	Guideline	24-hour	50	OS2	0.8	1.6%
PM$_{10}$	Guideline	24-hour	50	OS3	1.1	2.2%
PM$_{2.5}$	Canada-Wide Standard[3]	24-hour	30	OS1	0.3	1.0%
PM$_{2.5}$	Canada-Wide Standard[3]	24-hour	30	OS2	0.5	1.7%
PM$_{2.5}$	Canada-Wide Standard[3]	24-hour	30	OS3	0.6	2.0%

[1] Based on NO to NO$_2$ conversion rates from the Janssen Method
[2] Based on 100% NO to NO$_2$ conversion at stack top
[3] Canada-Wide Standard: achievement based on the 98th percentile measured annually, averaged over 3 consecutive years

Table 5.4b
Maximum Predicted Incremental Concentrations (µg/m³) of Inorganic and Organic
Compounds Due to Unit #5 Emissions with Relevant Ambient Air Quality Criteria

Contaminant	Jurisdiction/Criterion Classification	Averaging Period	Criterion Value	Operational Scenario	Maximum Predicted Ground-level Concentration	Percent of Applicable Criterion[4]
HCl	Manitoba Guideline	1-hour	100	OS1, OS2, OS3	0.19	0.19%
HF	Alberta Objective	1-hour	4.9	OS1, OS2, OS3	0.18	3.7%
	Manitoba Guideline	24-hour	0.85	OS1, OS2, OS3	0.013	1.5%
Formaldehyde	Manitoba Guideline	1-hour	60	OS1, OS2, OS3	0.006	0.01%
Benzene	Alberta Objective	1-hour	30	OS1, OS2, OS3	0.030	0.1%
Naphthalene	Ontario - AAQC[5] (Health)	24-hour	22.5	OS1, OS2, OS3	0.0006	0.003%
Styrene	Ontario Standard	24-hour	400	OS1, OS2, OS3	0.00004	0.00001%
Toluene	Ontario - AAQC (Odour)	24-hour	2000	OS1, OS2, OS3	0.0004	0.00002%
Xylenes	Ontario Standard	24-hour	730	OS1, OS2, OS3	0.0001	0.00001%
Trace Inorganics[a]						
Antimony	Ontario Standard	24-hour	25	OS3	0.000011	0.00004%
Arsenic	Manitoba Guideline	24-hour	0.3	OS3	0.00013	0.04%
Barium	Ontario - AAQC	24-hour	10	OS3	0.029	0.3%
Beryllium	Ontario Standard	24-hour	0.01	OS3	0.000016	0.16%
Boron	Ontario Standard	24-hour	120	OS3	0.0049	0.004%
Cadmium	Manitoba Guideline	24-hour	2	OS3	0.00001	0.0004%
Chromium	Alberta Objective Ontario – AAQC	1-hour 24-hour	1 1.5	OS3 OS3	0.0063 0.00046	0.6% 0.03%
Cobalt	Ontario - AAQC	24-hour	0.1	OS3	0.00003	0.03%
Copper	Manitoba Guideline	24-hour	50	OS3	0.0007	0.0014%
Lead	Manitoba Guideline	24-hour	2	OS3	0.00015	0.007%
Lithium	Ontario Standard	24-hour	20	OS3	0.0005	0.002%
Manganese	Ontario – AAQC	24-hour	2.5	OS3	0.0007	0.03%
Mercury	Ontario Standard	24-hour	2	OS3	0.0001	0.007%
Molybdenum	Ontario – AAQC	24-hour	120	OS3	0.0004	0.0003%
Nickel	Manitoba Guideline	24-hour	2	OS3	0.0004	0.02%
Selenium	Ontario – AAQC	24-hour	6	OS3	0.0001	0.0017%
Silver	Ontario Standard	24-hour	1	OS3	0.00003	0.003%
Strontium	Ontario – AAQC	24-hour	120	OS3	0.006	0.005%
Tin	Ontario Standard	24-hour	1	OS3	0.003	0.3%
Vanadium	Ontario Standard	24-hour	2	OS3	0.0005	0.025%
Zinc	Manitoba Guideline	24-hour	120	OS3	0.0001	0.0001%

[a] Predicted concentrations for the operating scenarios OS1 and OS2 would be equal or lower

5.2.1 Common Air Contaminants

Common air contaminants include CO, SO_2, NO_2 and particulate matter (SPM, PM_{10} and $PM_{2.5}$). Table 5.4a lists the maximum predicted concentrations at the maximum generation rate of 105 MW, and the appropriate time-based ambient air quality criteria. Note that for averaging periods greater than 1-hour, the predicted concentrations are considered to be conservative values, in the sense that they overestimate the actual concentrations that are likely to occur. The values are conservative because it has been assumed that the Brandon G.S. Unit #5 is capable of operating at the maximum sustained generation rate throughout the averaging period (e.g., 2,520 MWh - 105 MW for 24 hours). This is an unrealistic assumption because, in practice, the facility has a practical maximum of 90% of its rated capacity over prolonged periods of operation.

With the exception of CO, contoured plots of maximum air concentrations are shown for each common air contaminant, at appropriate averaging periods for comparison to Manitoba's ambient air quality objectives and guidelines. As indicated in Table 5.4a, predicted air concentrations of CO are far below applicable air quality criteria. This is also the case for suspended particulate matter. However, due to increased awareness of the potential health effects of suspended particulate matter, plots for the different size fractions of suspended particulate matter are also provided.

Additional discussion is provided with maximum NO_2 predictions resulting from Brandon G.S. emissions, as both the choice of burner row combination for fuel supply feed and modelling methodology play a significant role in the resultant predictions. OS2 emissions were used for the predictions shown in Table 5.3, as this combination leads to the highest emissions of CO, NO_2, SO_2, particulate matter and trace inorganics associated with particulate matter emissions using the current Spring Creek coal supply. On the other hand, Table 5.4a lists the predicted concentrations for both OS1 and OS2 for the common air contaminants (NO_2, CO, SO_2, SPM, PM_{10} and $PM_{2.5}$). In addition, Table 5.4a lists the predicted NO_2 concentrations assuming both 100% conversion of NO to NO_2 and a more realistic estimate based on the Janssen method of estimating NO conversion rates in power plant plumes. Since the predicted concentrations of particulate matter are so low, only the higher predicted concentrations for OS3 are listed for the trace inorganic elements associated with particulate matter in Table 5.4b. The predicted VOC concentrations are assumed to be the same for all three operating scenarios

5.2.1.1 *Nitrogen Dioxide (NO₂)*

Most of the NO_2 related to emissions from the Brandon G.S. is not emitted directly, but is chemically formed by oxidation of NO. The NO is subsequently chemically transformed into NO_2 by oxidation of NO as the emission plume is transported downwind. The conversion of NO

to NO_2 is not constant as it is related to solar intensity and therefore drops to near zero during the evening (Godish 1991). The oxidation of NO to NO_2 is predominantly driven by gas-phase reactions and is largely dependent on the availability and variety of free radicals such as ozone (Radojevic 1992).

It is common for air quality assessments used in regulatory permitting applications to simply assume that all NO is converted to NO_2 at stack top; this is simply due to the fact that regulatory dispersion models cannot accurately represent the complex chemical conversions that occur over time. The assumption of 100% conversion at the stack tip leads to significant over-prediction of short-term concentrations of NO_2, but may be more reasonable for long-term concentrations (at distances further from the source).

Alternative regulatory approaches to dealing with this issue are to: 1) use the Ozone Limiting Method (OLM) which sets an upper limit on the conversion of NO to NO_2 based on the relative amount of ozone present in the atmosphere, or 2) use the ratio of measured NO to NO_2 from a nearby ambient monitoring station to estimate the amount of NO converted to NO_2 on an hourly basis. The OLM method is not appropriate for a large plume such as that emitted from the Brandon G.S. because it assumes rapid and complete mixing of the plume with the ozone in the ambient air. In actual fact, power plant plumes can maintain their shape for some distance downwind, only gradually mixing with ambient air as the plume is transported downwind. Thus, the OLM method also over predicts NO_2 conversion rates. Although NO and NO_2 are monitored at the Assiniboine Community College in Brandon, the ratio of the two NO_x fractions at this location is likely more representative of emissions from vehicular traffic than of the NO/NO_2 ratio in the Brandon G.S. plume. Consequently, the NO/NO_2 ratio method is also not appropriate in this situation.

For the purposes of this air quality assessment, the predicted ground-level concentrations of NO_2 are assessed with two different methodologies:

1. use of the actual, measured maximum NO_x emission rate, and assuming 100% conversion at stack top; and,
2. use of the actual, measured maximum NO_x emission rate and application of a published, empirically-derived methodology to estimate conversion rates of NO to NO_2 in power plant plumes.

Method #2 requires further discussion. The methodology used to estimate NO/NO_2 conversion rates was developed in 1988 (Janssen 1988) and presented within a predictive equation that was subsequently validated with in-plume measurements from oil, gas and coal-fired power plants. This methodology has been recently applied in other work (de Oliviera and Simonsen 2003).

The predictive equation (referred to here as the 'Janssen equation') developed in the original work used NO emissions from the Unit #5 stack and CTs, along with local environmental factors that influence the conversion rates.

The Janssen conversion equation is shown below:

$$NO_2/NO = \Lambda(1 - e^{-\alpha x})$$

where Λ and α are constants that depend on atmospheric conditions.
x = distance from source

The Janssen article used the equation to develop Λ and α values by season, dependent on background ozone concentration and wind speed. The conversion rates dramatically increase with strong solar radiation and as such are at a maximum during the summer months. The Janssen work also determined the constants during mid-day, when the solar radiation was greatest. Since both 1-hour and 24-hour maximum concentrations of NO due to emissions from the Brandon G.S. occur during summer months with low wind speeds, the Λ and α values corresponding to summer months with wind speeds between 0 and 5 m/s were used. These values are 0.88 and 0.20 km^{-1}, respectively.

Table 5.5 lists the NO_2/NO conversion rates used for the Brandon analysis. It should be noted that the conversion rates were applied to all hours of the day for all seasons, when in fact the rates are representative of mid-day (maximum) conversion of NO to NO_2 in summertime. For this reason, the estimated maximum 24-hour average NO_2 concentrations derived using this method likely overestimate actual NO_2 impacts due to Unit #5 emissions, although not to the same extent as with the use of the 100% conversion rate method.

Table 5.5: NO/NO$_2$ Conversion Rates by Distance from the Brandon G.S. Stack
Janssen Methodology

Distance from Source (km)	NO$_2$/NO Conversion Rate (%)
0 – 1	7.4
1 - 2	29
2 – 3	40
3 – 5	56
5 – 8	70
8 – 11	78
11 - 15	84

The maximum ground-level NO_2 concentrations at each applicable averaging period, for each of the two prediction methodologies indicated above, are listed in Table 5.6. In addition, model predictions with both OS1 and OS2 are shown.

Table 5.6
Comparison of Maximum Predicted NO_2 Concentrations
Using Different Prediction Methodologies

Assessment Methodology	Maximum 1-hour Concentration[a] ($\mu g/m^3$)	Maximum 24-hour Concentration[a] ($\mu g/m^3$)	Annual Concentration[a] ($\mu g/m^3$)
Maximum Acceptable Objective	400	200	100
100% Conversion			
OS1	243.0	17.2	0.6
OS2	322.0	23.6	0.9
Janssen Method			
OS1	91.0	7.9	0.2
OS2	119.0	10.4	0.2

[a] background concentrations not included

Table 5.6 shows that use of the Janssen conversion rates of NO to NO_2 leads to much lower predictions of ambient NO_2 concentrations. For the maximum 1-hour concentration and 24-hour concentration, the Janssen methodology likely produces estimates closest to reality.

A frequency distribution for maximum ambient NO_2 concentrations was developed to determine how often relatively high off-site concentrations can be expected to occur. The concentrations are relative to the point of maximum impingement, which is immediately to the west of the Brandon G.S. fenceline (see Figure 5.1). Table 5.7 shows percentile concentration values for both the 100% conversion method and the Janssen conversion method. To be conservative, each assumes upper-bound operating conditions (i.e., OS2).

The frequency distribution shows that relatively high 1-hour average concentrations occur very infrequently and should not be expected to occur more than once or twice a year. The atmospheric conditions leading to the high 1-hour average values are slightly unstable conditions with medium-to-high wind speeds (the model estimate during the hour was 4.8 m/s at the surface), causing air at higher elevations to rapidly descend to the surface in short bursts. These conditions do not extend for lengthy periods, which is why the maximum 24-hour concentrations are substantially lower than the 1-hour average values. The second-highest predicted 1-hour average NO_2 concentration was just 50% of the maximum values shown in Table 5.7.

Table 5.7
Frequency Distribution of Maximum Predicted NO_2 Concentrations
Due to Unit # 5 Emissions
(Operating Scenario OS2)

Percentile Concentration	Maximum 1-hour Concentration[a] ($\mu g/m^3$)		Maximum 24-hour Concentration[a] ($\mu g/m^3$)	
	100% Conversion	Janssen Method	100% Conversion	Janssen Method
Maximum Acceptable Objective	400	400	200	200
100	322	119	24	10
99.95	73	32	22	10
99.9	52	23	20	8
99.5	18	8	13	4
99	10	4	12	3
98	2	1	7	3
90	0.2	0.1	1	0.3
50	0.0	0.0	0.0	0.0

[a] background concentrations not included

Figure 5.2 presents the maximum predicted 1-hour average NO_2 concentrations using the conservative assumptions of OS2 and 100% conversion of NO to NO_2. The maximum 1-hour concentrations using the Janssen conversion rates are shown in Figure 5.3. Figures 5.4 and 5.5 show the corresponding concentrations using the OS1.

Figures 5.6 and 5.7 show the predicted 24-hour average maximum NO_2 concentrations using the 100% NO/NO_2 conversion method and the Janssen method, respectively, OS2. Figures 5.8 and 5.9 show the corresponding concentrations using OS1. Use of the Janssen method predicts maximums to occur at a similar location to the 100% conversion method, since a sizeable fraction of the NO_x emitted is in the form NO_2 (based on stack monitoring data), and only the remaining fraction (considered as NO) is subjected to the Janssen conversion rates.

Figure 5.10 shows that annual average concentrations of NO_2 due to Unit #5 emissions are very low throughout the region, even when its is assumed that 100% of the NO is converted to NO_2 for the higher emissions of OS2. Due to the very low levels predicted for OS2, the results for OS1, which are lower, are not shown.

Figure 5.2
Maximum Predicted Incremental 1-hour Average NO$_2$ Concentrations (μg/m^3)
due to Unit #5 Emissions
Using 100% Conversion of NO to NO$_2$ at Stack Top
(Operating Scenario OS2)
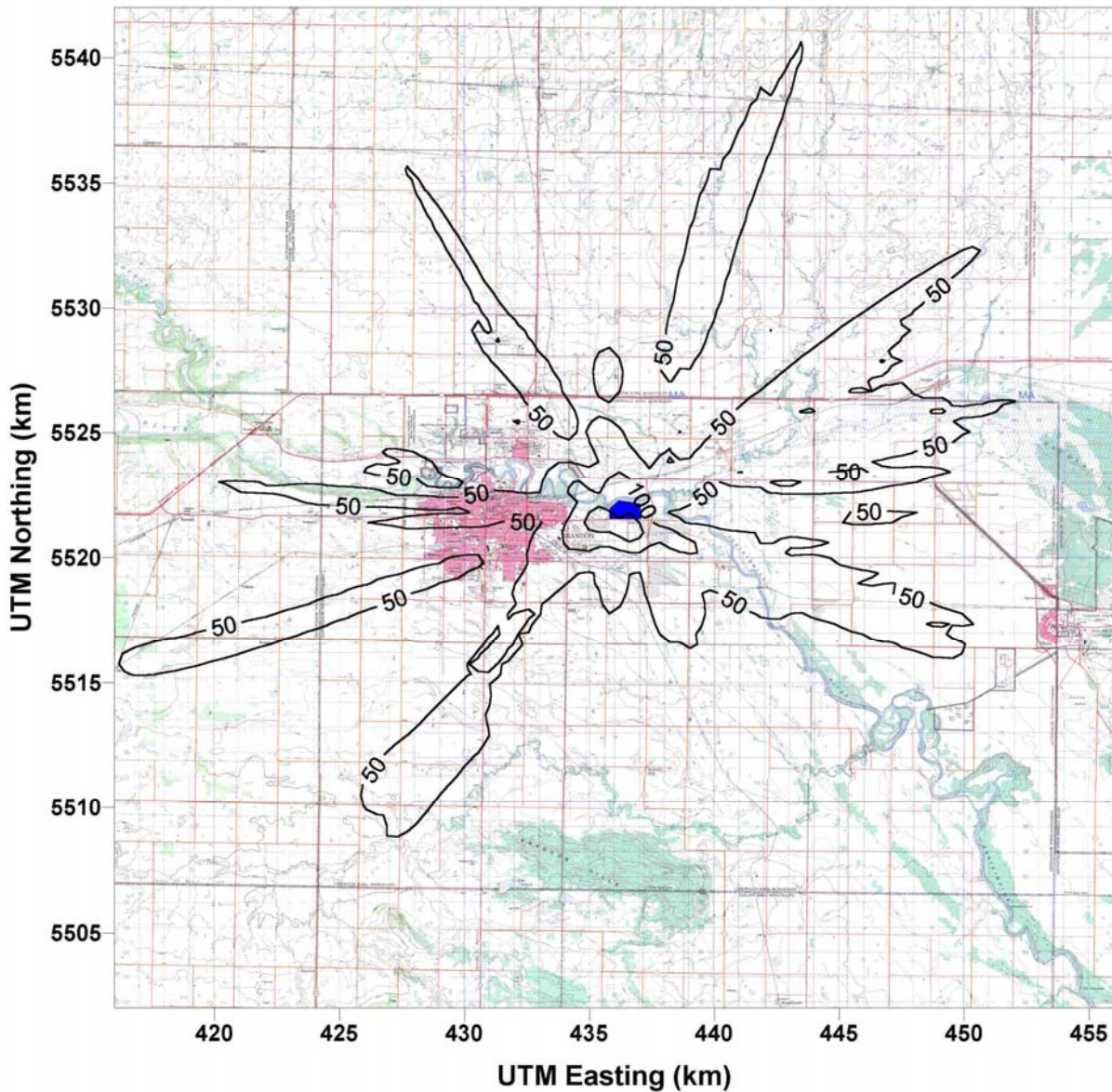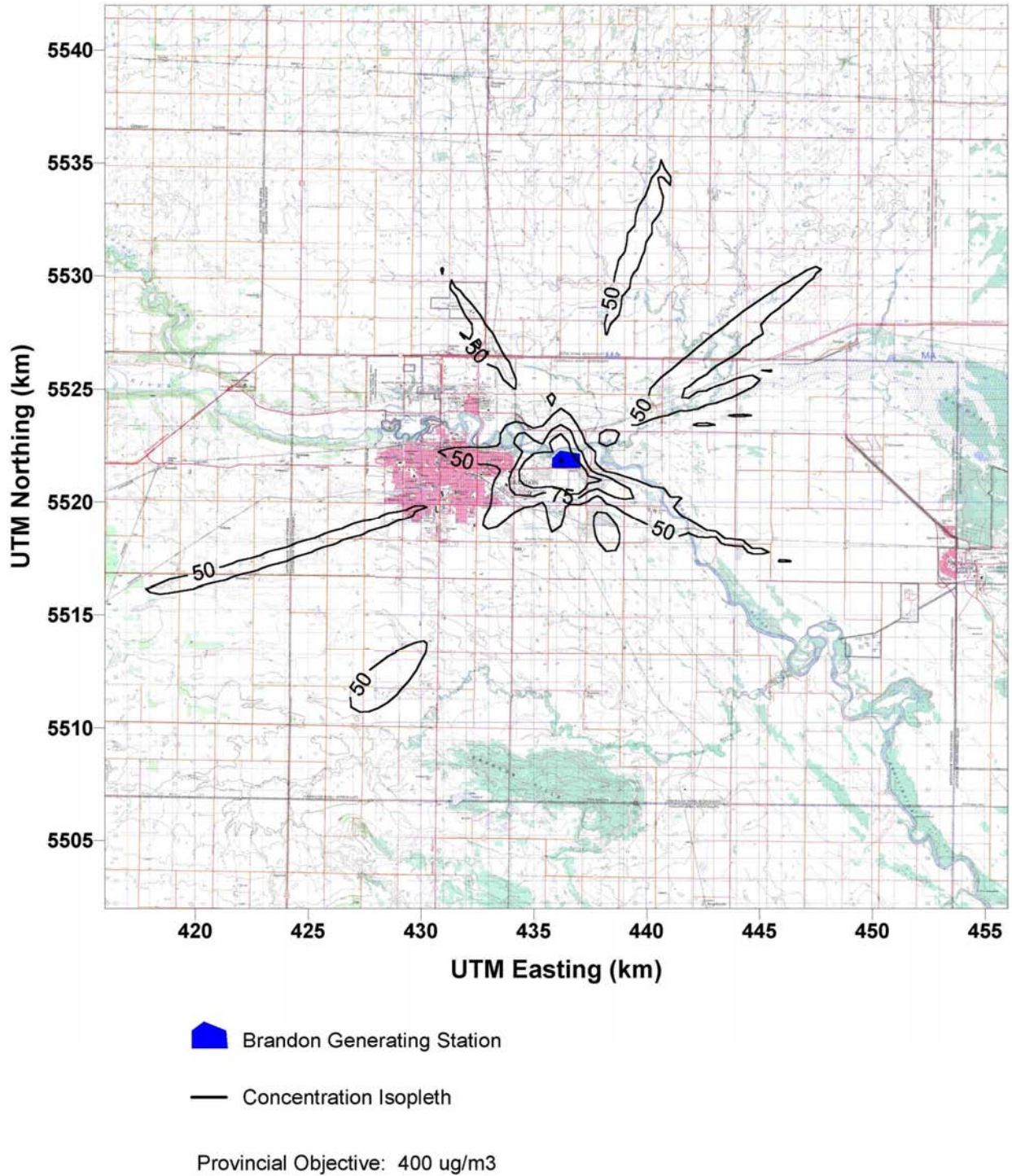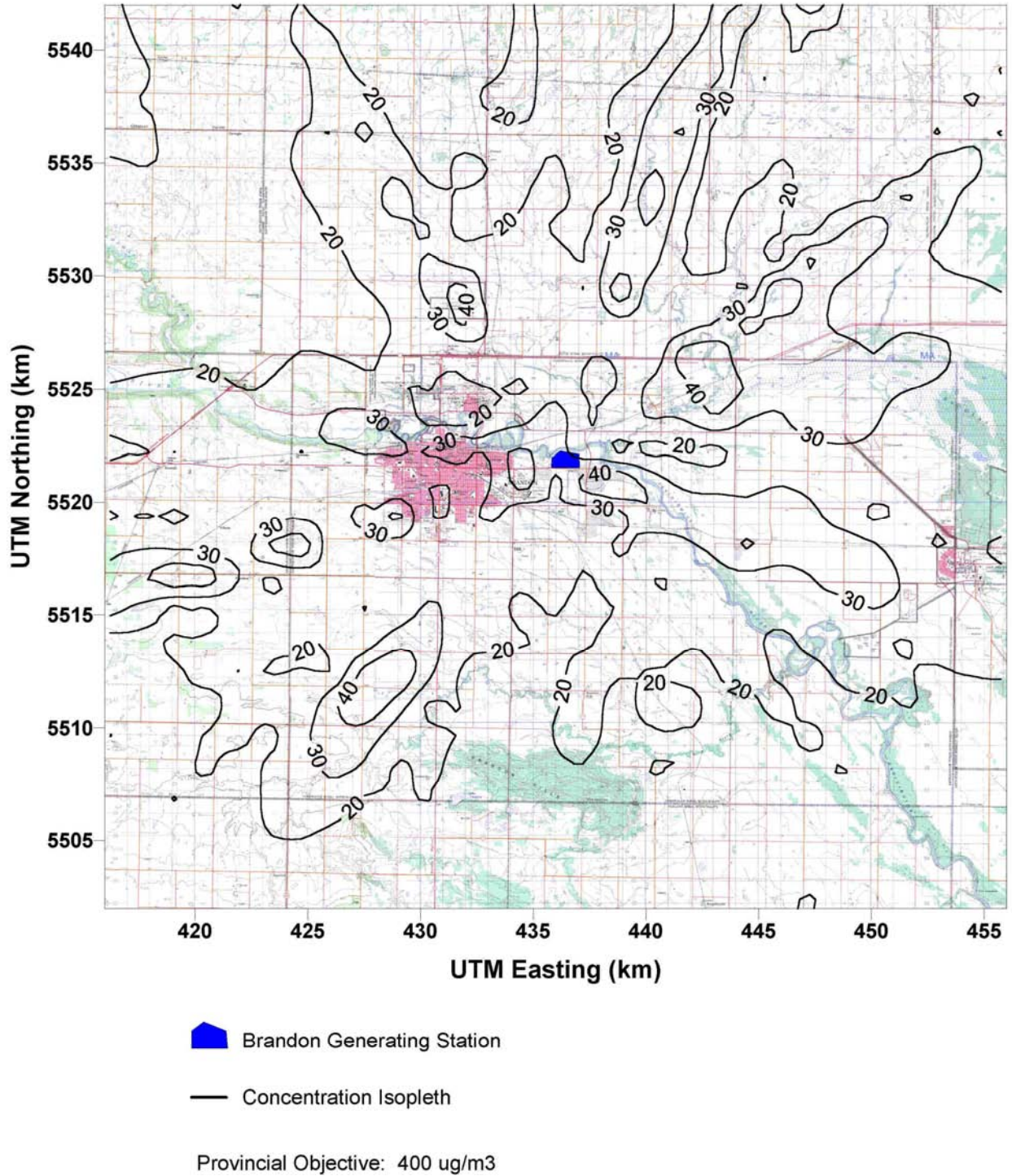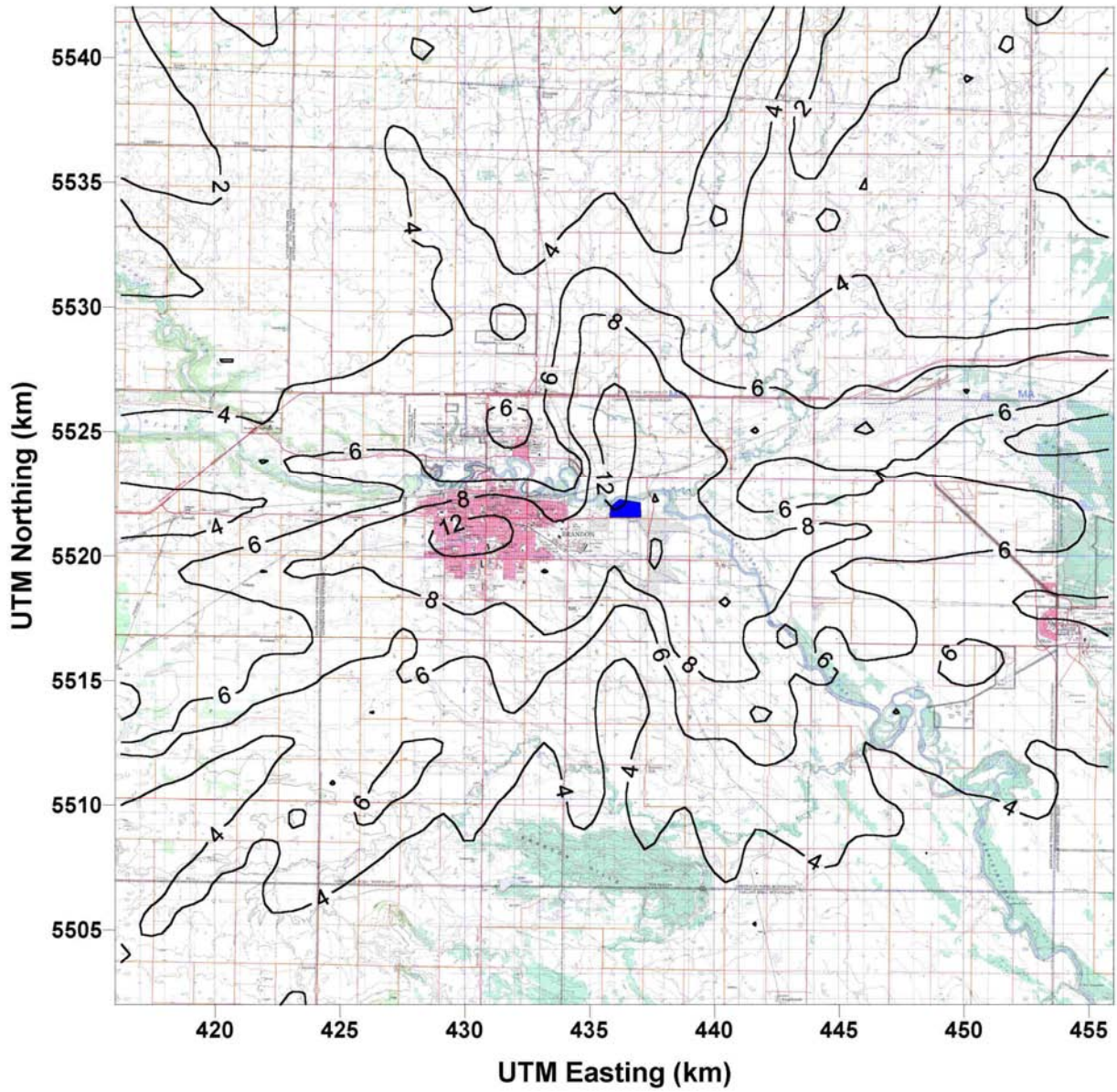
Figure 5.3
Maximum Predicted Incremental 1-hour Average NO$_2$ Concentrations (μg/m^3)
due to Unit #5 Emissions
Using Janssen Conversion Rates of NO to NO$_2$
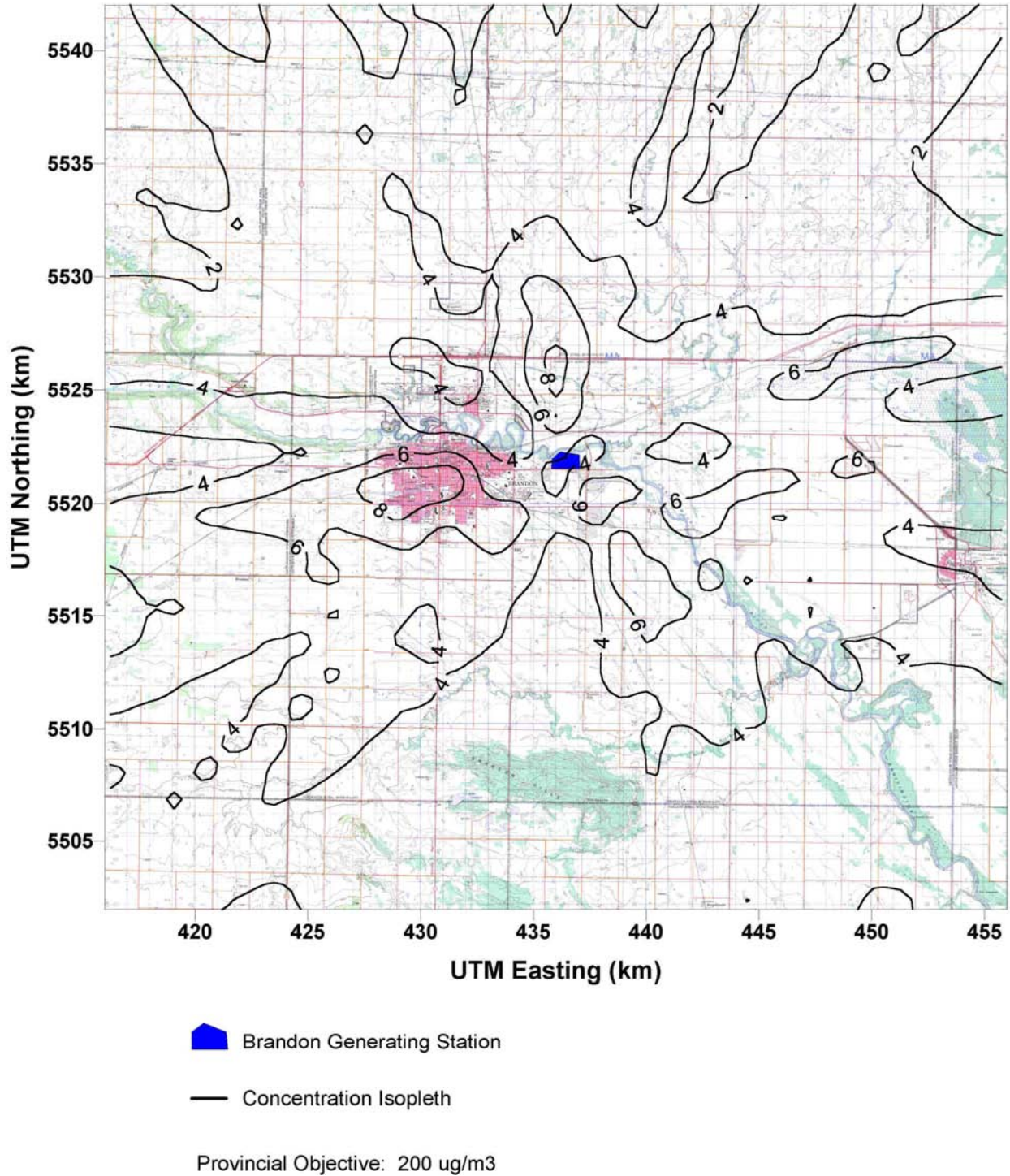(Operating Scenario OS2)
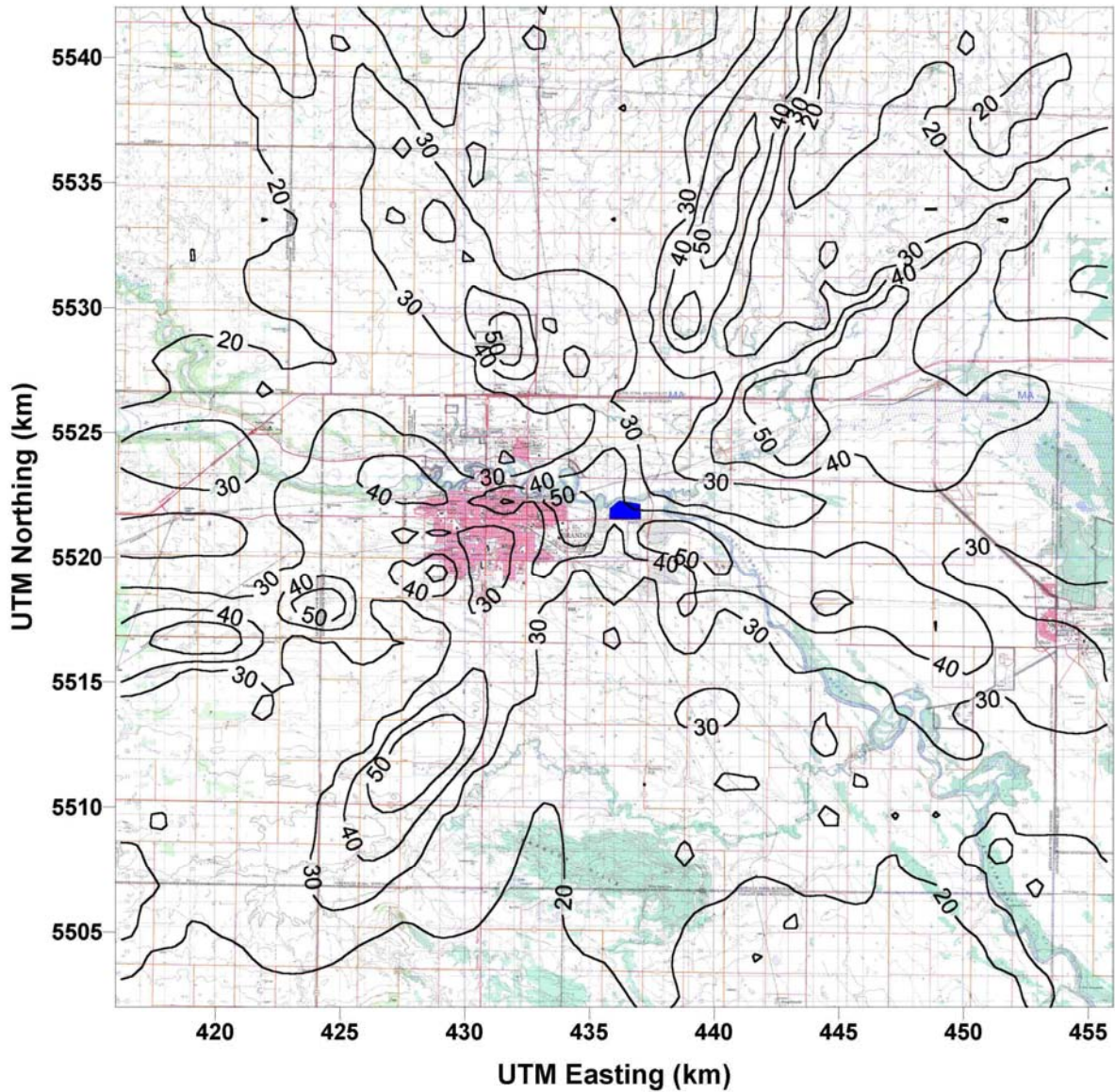
Figure 5.4
Maximum Predicted Incremental 1-hour Average NO$_2$ Concentrations (µg/m^3)
due to Unit #5 Emissions
Using 100% Conversion of NO to NO$_2$ at Stack Top
(Operating Scenario OS1)

Brandon Generating Station

— Concentration Isopleth
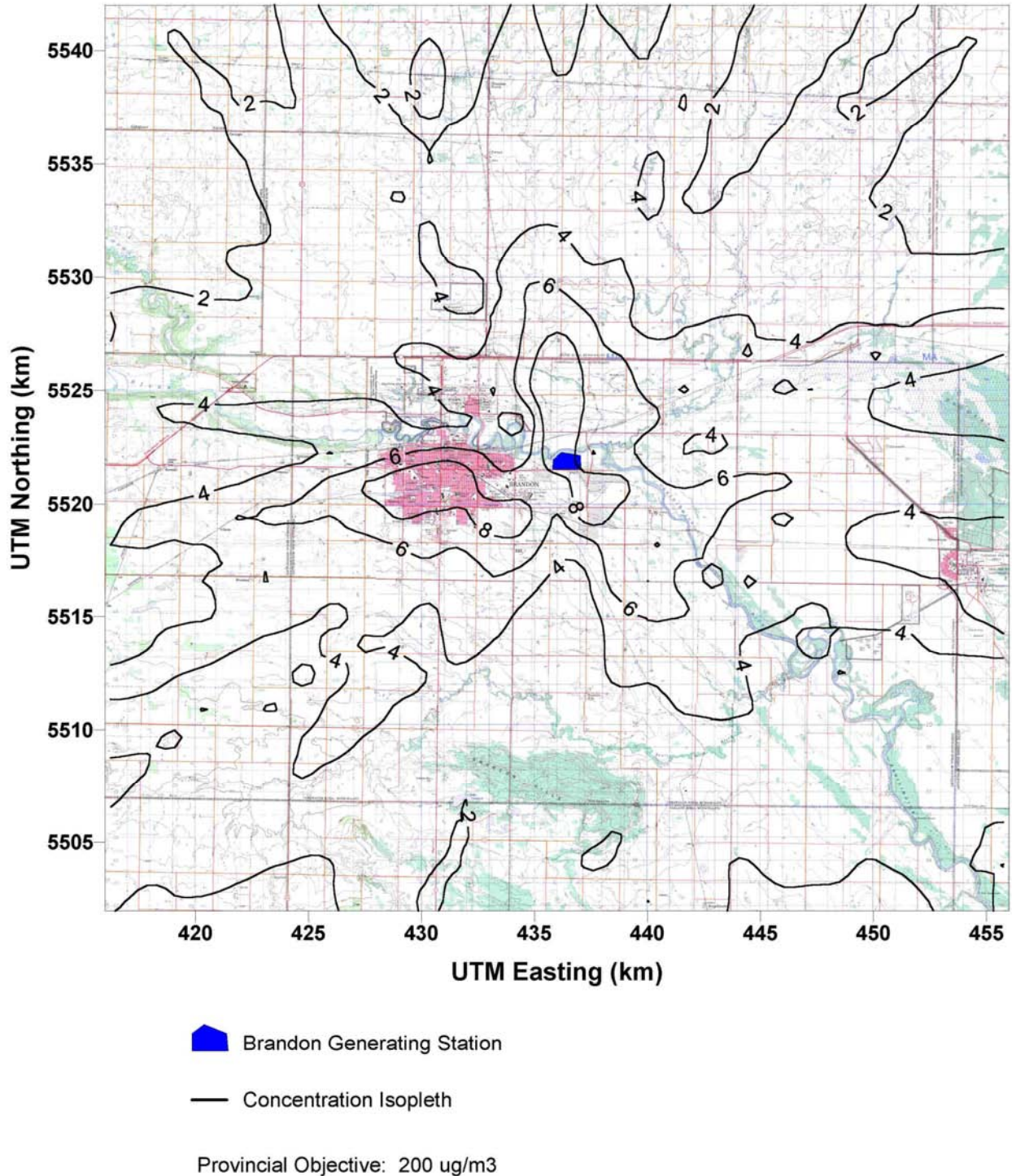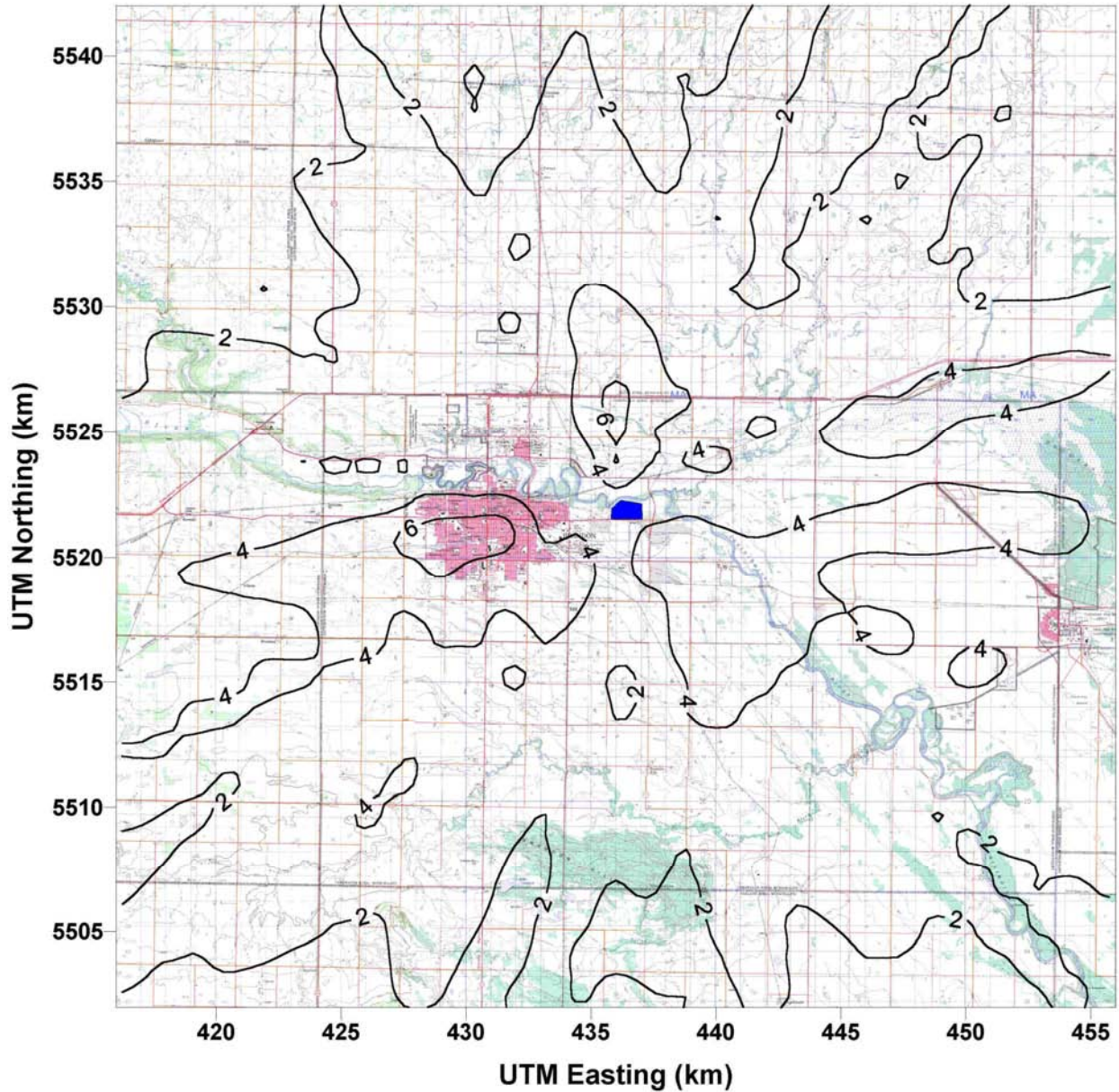
Provincial Objective: 400 ug/m3

Figure 5.5
Maximum Predicted Incremental 1-hour Average NO$_2$ Concentrations (μg/m^3)
due to Unit #5 Emissions
Using Janssen Conversion Rates of NO to NO$_2$
(Operating Scenario OS1)

Brandon Generating Station

—— Concentration Isopleth

Provincial Objective: 400 ug/m3

Figure 5.6
Maximum Predicted Incremental 24-hour Average NO$_2$ Concentrations (µg/m^3)
due to Unit #5 Emissions
Using 100% Conversion Method of NO to NO$_2$
(Operating Scenario OS2)

Figure 5.7
Maximum Predicted Incremental 24-hour Average NO$_2$ Concentrations (µg/m^3)
due to Unit #5 Emissions
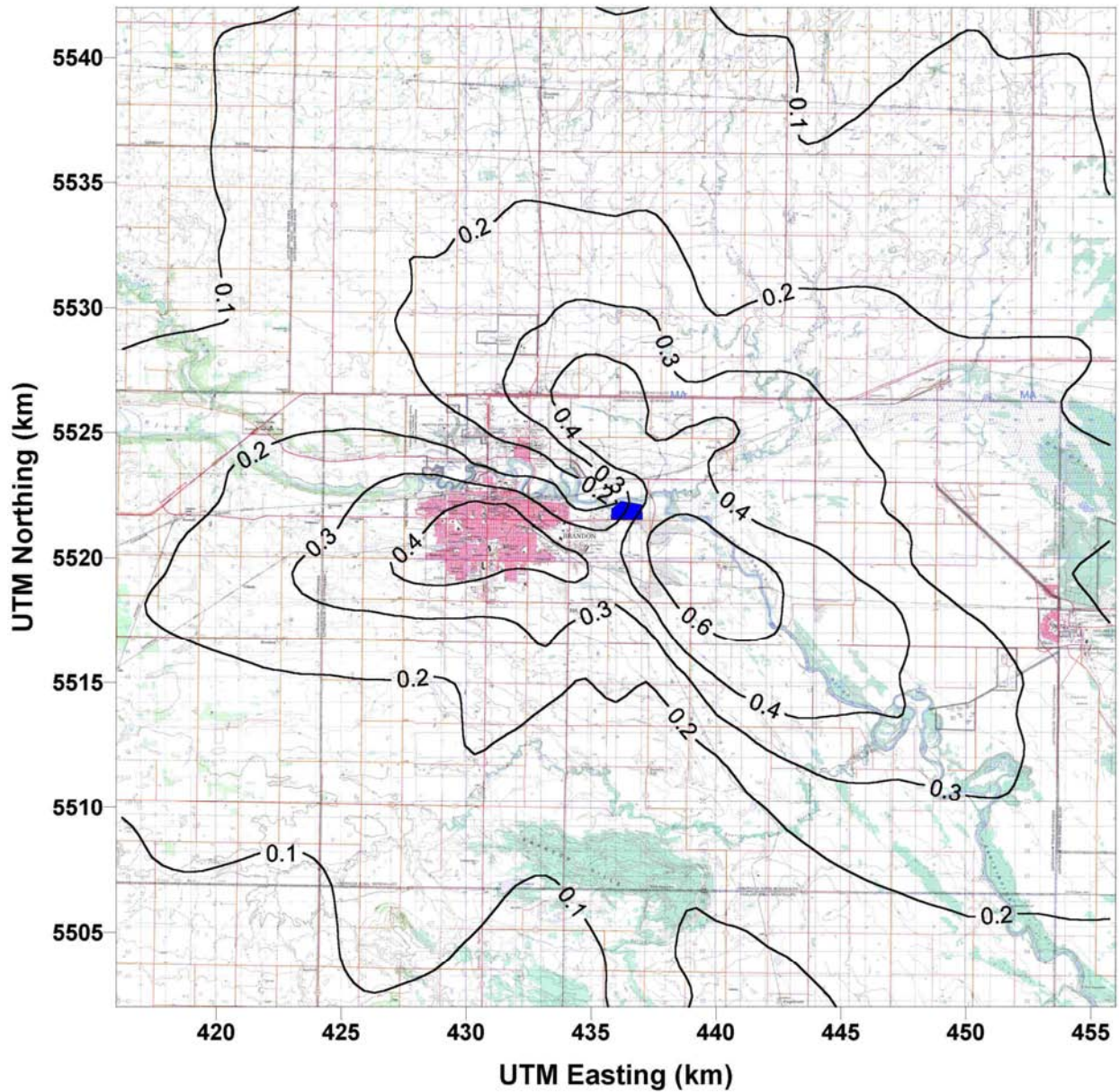**Using Janssen Conversion Rates of NO to NO$_2$**
(Operating Scenario OS2)

Brandon Generating Station

Concentration Isopleth

Provincial Objective: 200 ug/m3

Figure 5.8
Maximum Predicted Incremental 24-hour Average NO$_2$ Concentrations (μg/m^3)
due to Unit #5 Emissions
Using 100% Conversion Method of NO to NO$_2$
(Operating Scenario OS1)

Figure 5.9
Maximum Predicted Incremental 24-hour Average NO_2 Concentrations ($\mu g/m^3$)
due to Unit #5 Emissions
Using Janssen Conversion Rates of NO to NO_2
(Operating Scenario OS1)

Figure 5.10
Maximum Predicted Incremental Annual Average NO$_2$ Concentrations (µg/m^3)
due to Unit #5 Emissions
Using 100% Conversion Method of NO to NO$_2$
(Operating Scenario OS2)

5.2.1.2 Sulphur Dioxide

The maximum predicted 1-hour average SO_2 concentration of 200 µg/m^3 for the higher emitting operating scenario OS2 is predicted to occur close to the south-west perimeter of the Brandon G.S. This represents about 20% of the provincial Maximum Acceptable concentration level. The results for OS1 are not shown, but the maximum predicted 1-hour average SO_2 concentration is 190 µg/m^3. As shown in Figure 5.11, maximum predicted SO_2 concentrations within the residential areas of Brandon for OS2 are predicted to be between 20 and 60 µg/m³, compared with Manitoba's Maximum Acceptable level of 900 µg/m^3.

Figure 5.12 illustrates the maximum predicted 24-hour average SO_2 concentrations due to emissions from Unit #5 for OS2. The maximum predicted concentration of 14.6 µg/m³ also occurs close to the property fenceline, and represents approximately 5% of the provincial Maximum Acceptable level of 300 µg/m³. The results for the lower emissions of OS1 are not shown, but the maximum predicted 24-hour average SO_2 concentration is 13.9 µg/m^3.

On an annual basis (Figure 5.13), the maximum impacts of ambient sulphur dioxide are less than 1% of the provincial objective, in all areas surrounding the Brandon G.S.

For the potentially higher SO_2 emissions under OS3, predicted ambient SO_2 concentrations could be expected to be not more than 33% higher (see Table 3.4) than indicated in Figures 5.11 and 5.12 if one of the candidate coals (coal mine F) were to be used in future operations. For coal from other mines (e.g., mines B, E and P), SO_2 impacts could be from 10% to 37% lower than the impacts shown in Figures 5.11, 5.12 and 5.13.

As discussed in Section 4.0, it can reasonably be assumed that the Brandon G.S. is the largest source of SO_2 emission in the area, and that the SO_2 concentrations calculated for Brandon G.S. based on dispersion modelling can be directly compared with the ambient air quality objectives for Manitoba, without consideration of additional background SO_2 levels. Figures 5.11 and 5.12 indicate that the predicted 1-hour and 24-hour average SO_2 concentrations would be well below the relevant air quality objectives using coal with the current sulphur content of 0.34%. Of the alternative candidate coal mines that might be considered by Manitoba Hydro as future suppliers of fuel to the Brandon G.S., the highest sulphur content would be 0.4% (see Table 3.2). Therefore, use of any of the other potential sources of coal for Unit #5 would not cause ambient levels of SO_2 to exceed the provincial objectives.

Figure 5.11
Maximum Predicted Incremental 1-hour Average SO$_2$ Concentrations (µg/m^3)
due to Unit #5 Emissions
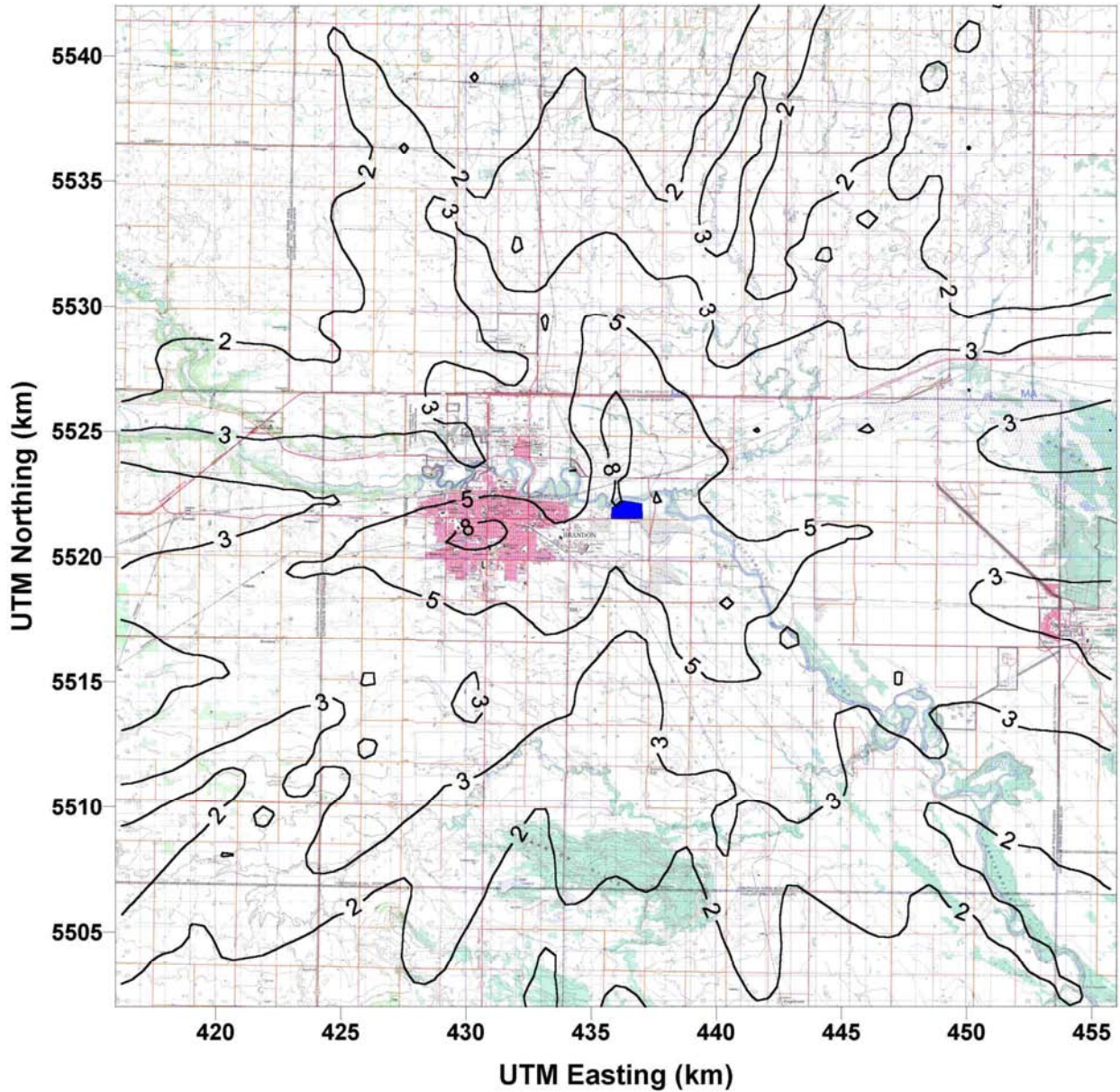(Operating Scenario OS2)
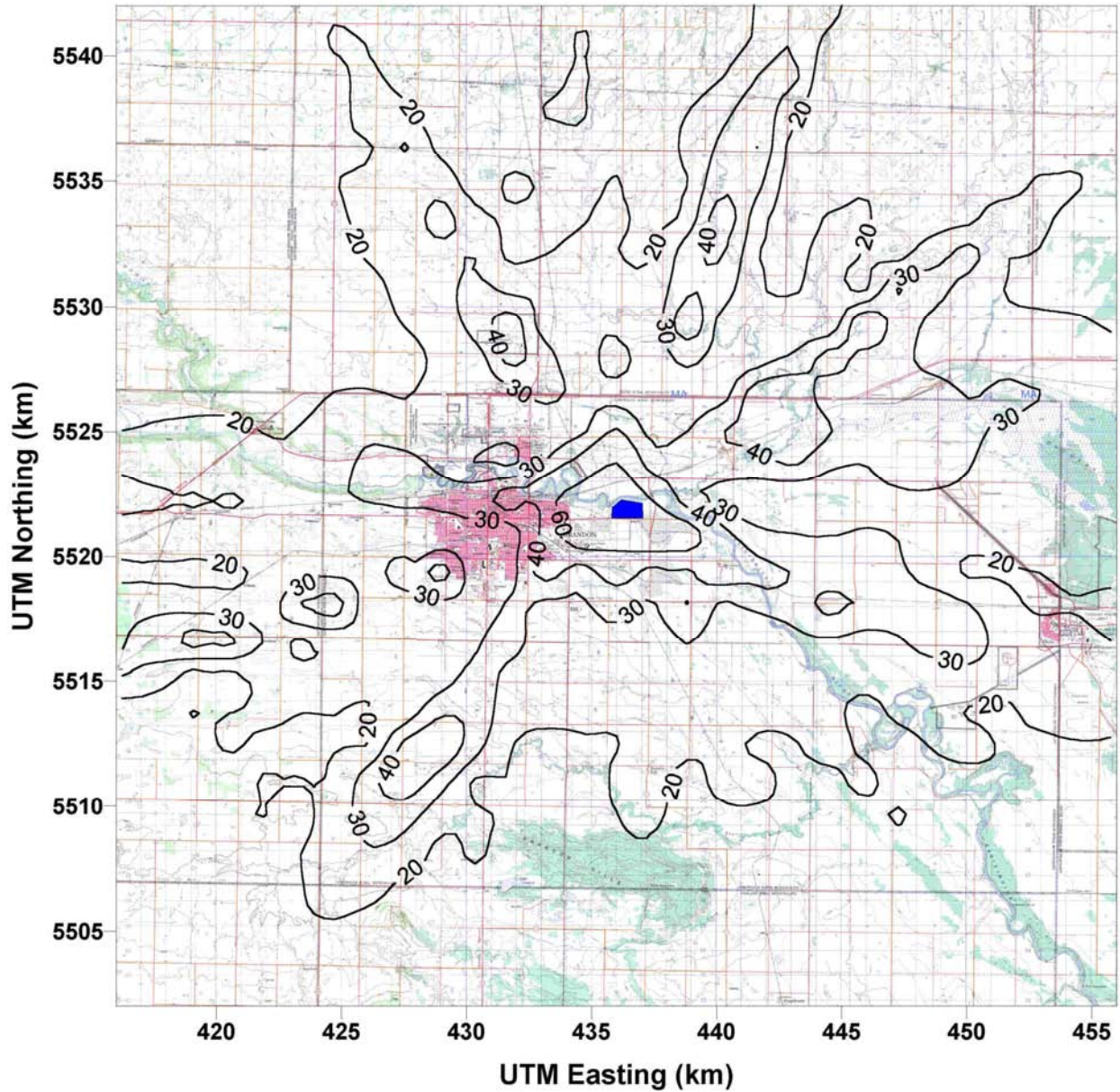
■ Brandon Generating Station

— Concentration Isopleth

Provincial Objective: 900 ug/m3

Figure 5.12
Maximum Predicted Incremental 24-hour Average SO$_2$ Concentrations (μg/m^3)
due to Unit #5 Emissions
(Operating Scenario OS2)

Figure 5.13
Maximum Predicted Incremental Annual Average SO$_2$ Concentrations (µg/m^3)
due to Unit #5 Emissions
(Operating Scenario OS2)