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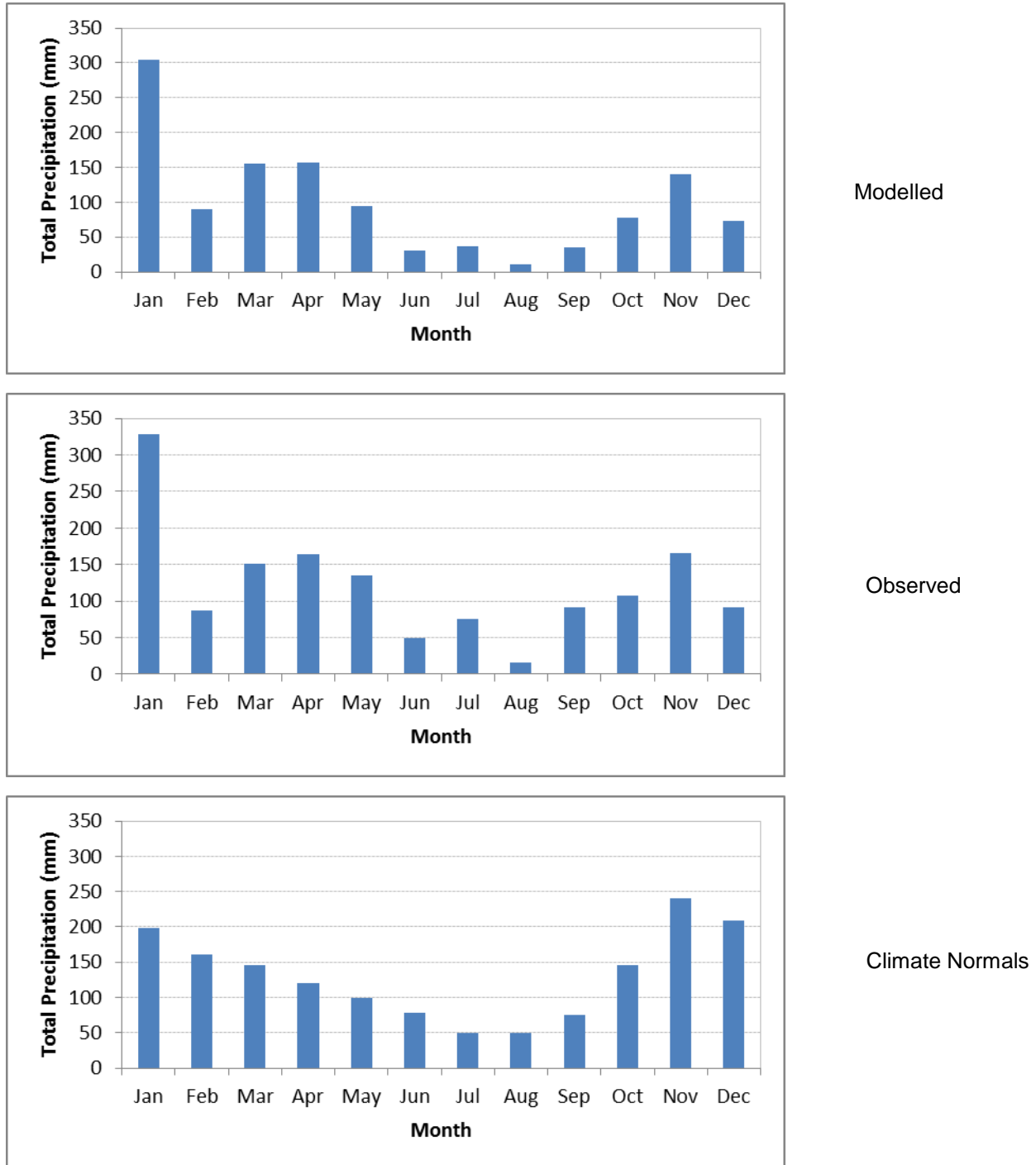
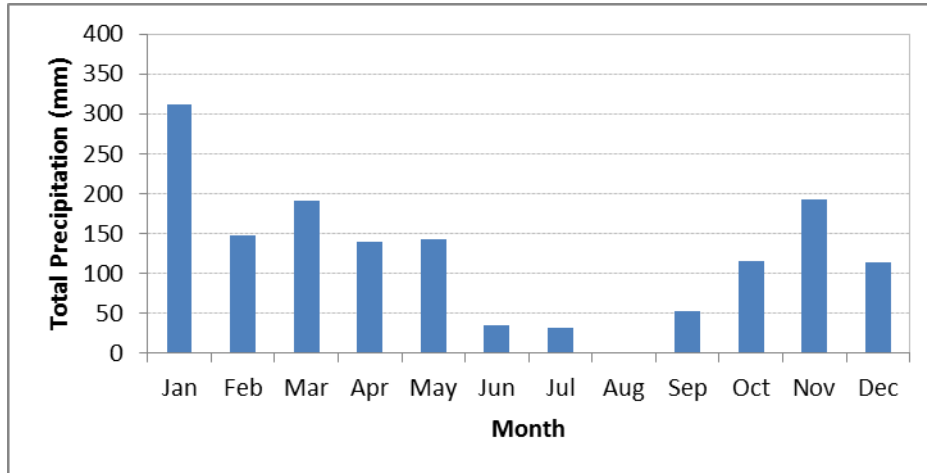


Figure D.30: Comparison of Modelled Precipitation with 2011 Observations and Climate Normal at Abbotsford Airport



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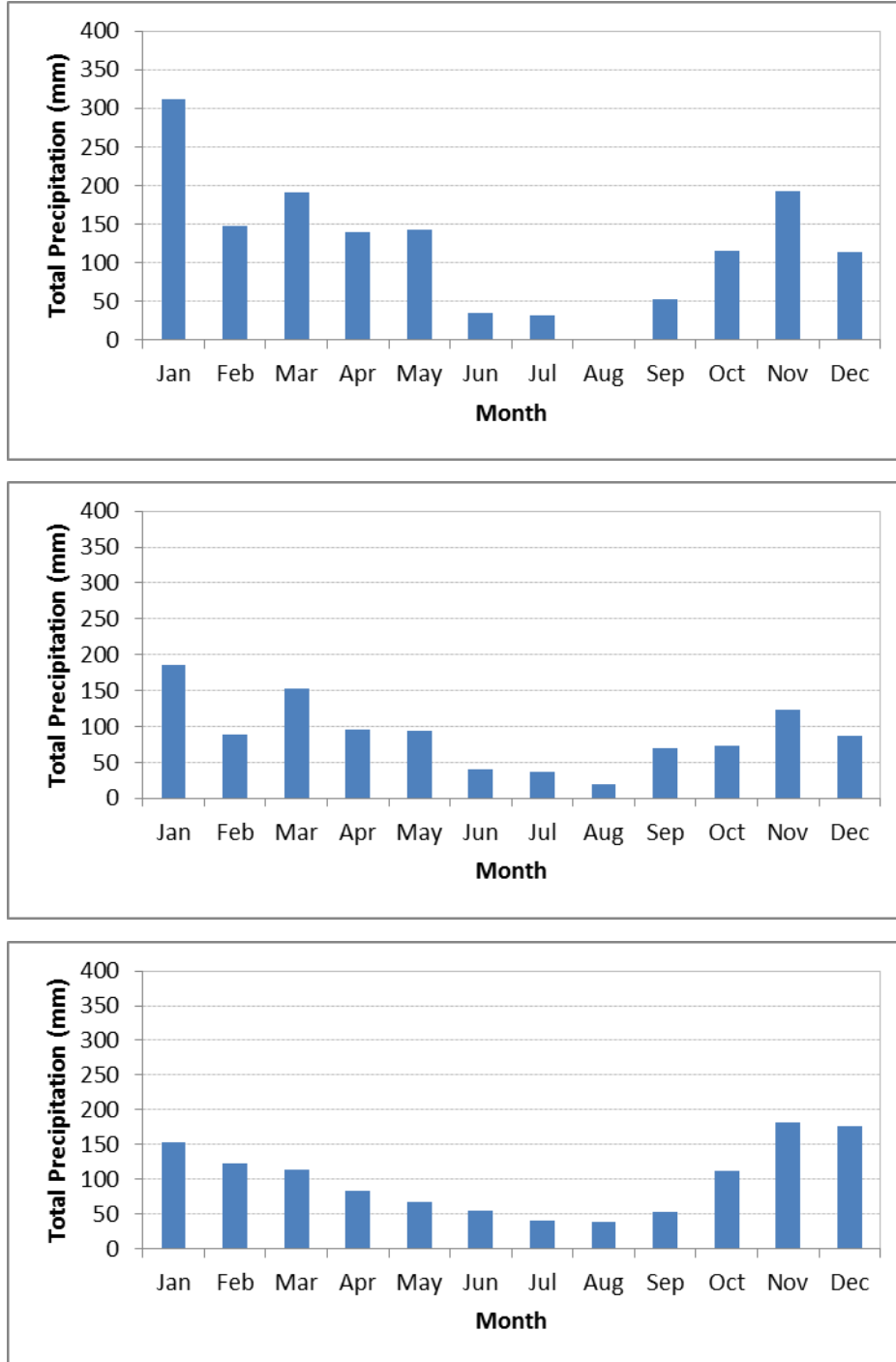


Burmount

Figure D.31: Monthly Distribution of Modelled Precipitation at Burnaby



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Modelled

Observed

Climate Normal

Figure D.32: Comparison of Modelled Precipitation at Burmount with 2011 Observations and Climate Normal at Vancouver International Airport

4. CALPUFF INPUTS

All technical options relating to the CALPUFF dispersion model were set according to Alberta *Air Quality Model Guideline* (AERSD 2013) and the *Guidelines for Air Quality Dispersion Modelling in British Columbia* (BC Ministry of Environment 2008), or to model defaults. These include parameters and options such as the calculation of plume dispersion coefficients, the plume path coefficients used for terrain adjustments, exponents for the wind speed profile, and wind speed categories. A list of the technical options is shown in Table D.11.

Table D.11: CALPUFF model switch settings

Parameter	Default	Project	Comments
MGAUSS	1	1	Gaussian distribution used in near field
MCTADJ	3	3	Partial plume path terrain adjustment
MCTSG	0	0	Sub-grid scale complex terrain not modelled
MSLUG	0	0	Near-field puffs not modelled as elongated
MTRANS	1	1	Transitional plume rise modelled
MTIP	1	1	Stack tip downwash used
MBDW	1	2	PRIME method used
MSHEAR	0	0	Vertical wind shear not modelled
MSPLIT	0	0	Puffs are not split
MCHEM	1	0	Chemical transformation not modelled
MAQCHEM	0	0	Aqueous phase transformation not modelled
MWET	1	1	Wet removal modelled for all sources
MDRY	1	1	Dry deposition modelled for all sources
MTILT	0	0	Gravitational settling not modelled
MDISP	3	2	Near-field dispersion coefficients internally calculated from sigma-v, sigma-w using micrometeorological variables as recommended by guidelines
MTURBVW	3	3	Not used since MDISP = 2
MDISP2	3	2	Not used since MDISP = 2
MCTURB	1	1	Standard CALPUFF subroutines used to compute turbulence sigma-v & sigma-w



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Parameter	Default	Project	Comments
MROUGH	0	0	PG sigma-y, sigma-z not adjusted for roughness
MPARTL	1	1	Partial plume penetration of elevated inversion
MTINV	0	0	Strength of temperature inversion computed from default gradients
MPDF	0	1	PDF used for dispersion under convective conditions as recommended for MDISP = 2
MSGTIBL	0	0	Sub-grid TIBL module not used for shoreline
MBCON	0	0	Boundary concentration conditions not modelled
MSOURCE	0	0	Individual source contributions not saved
MFOG	0	0	Do not configure for FOG model output
MREG	1	0	Do not test options specified to see if they conform to United States Environmental Protection Agency regulatory values



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5. REFERENCES

- Alberta Environment and Sustainable Resource Development. 2013. *Air Quality Model Guideline*. Edmonton, AB. 55 pp.
- BC Ministry of Environment. 2008. *Guidelines for Air Quality Dispersion Modelling in British Columbia*. 152 pp.
- Environment Canada. 2013. *Canadian Climate Normals or Averages 1971-2000*. Website: http://climate.weatheroffice.gc.ca/climate_normals/index_e.html. Accessed: April 2013.
- Oke, T.R. 1987. *Boundary Layer Climates*. 2nd edition. London, UK: Routledge.
- Statistics Canada. 2011. *Census Profile*. Available at: <http://www12.statcan.gc.ca/census-recensement/index-eng.cfm>
- United States Environmental Protection Agency (US EPA), 2008: *AERSURFACE User's Guide*, EPA-454/B-08-001.
- Zhang, L., Moran, M.D., Makar, P.A., Brook, J.R., and Gong, S. 2002. *Modelling gaseous dry deposition in AURAMS: a unified regional air-quality modelling system*. Atmospheric Environment 36: 537-560.
- Zhang, L., Brook, J.R., and Vet, R. 2003. *A revised parameterization of gaseous dry deposition in air-quality models*. Atmospheric Chemistry and Physics 3: 2067-2082.

APPENDIX E

CRITERIA AIR CONTAMINANTS

Edmonton Area

PM₁₀

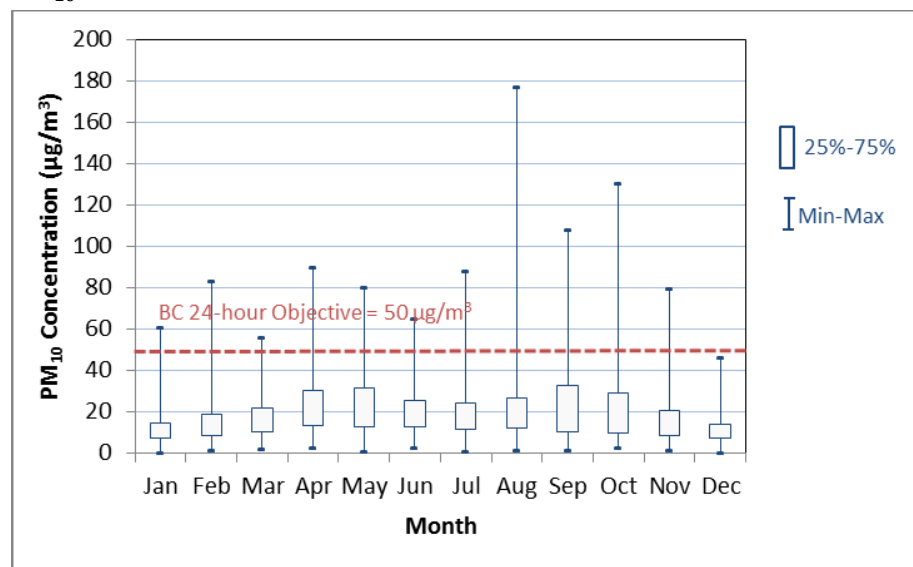


Figure E 1: Seasonal Variation of 24-Hour PM₁₀ Concentrations (µg/m³) at Edmonton South

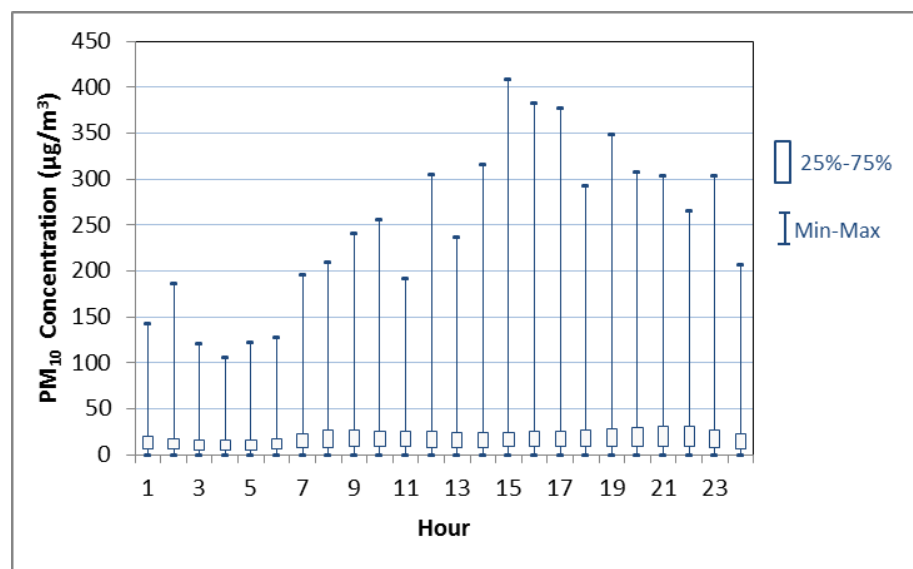


Figure E 2: Diurnal Variation of 1-Hour PM₁₀ Concentrations (µg/m³) at Edmonton South



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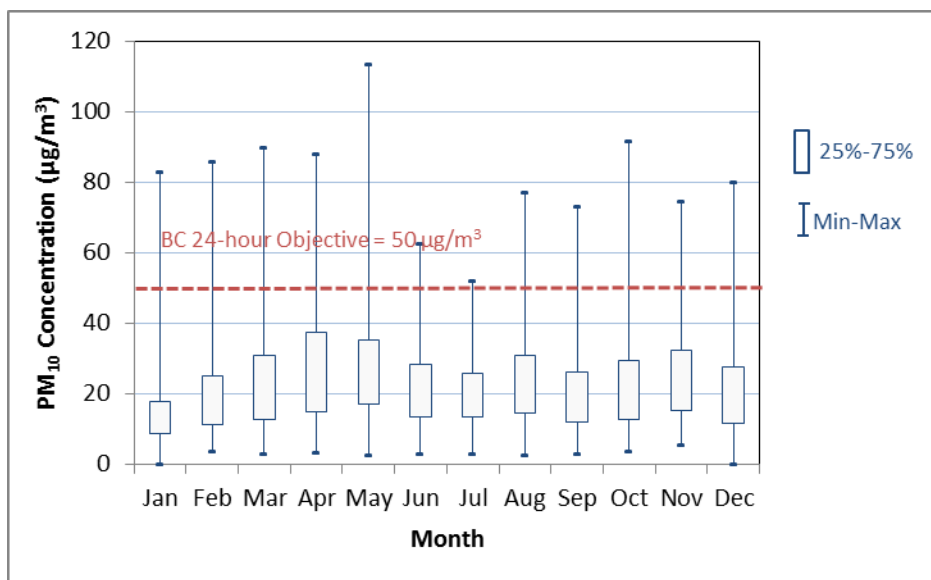


Figure E 3: Seasonal Variation of 24-Hour PM₁₀ Concentrations (µg/m³) at Edmonton Northwest

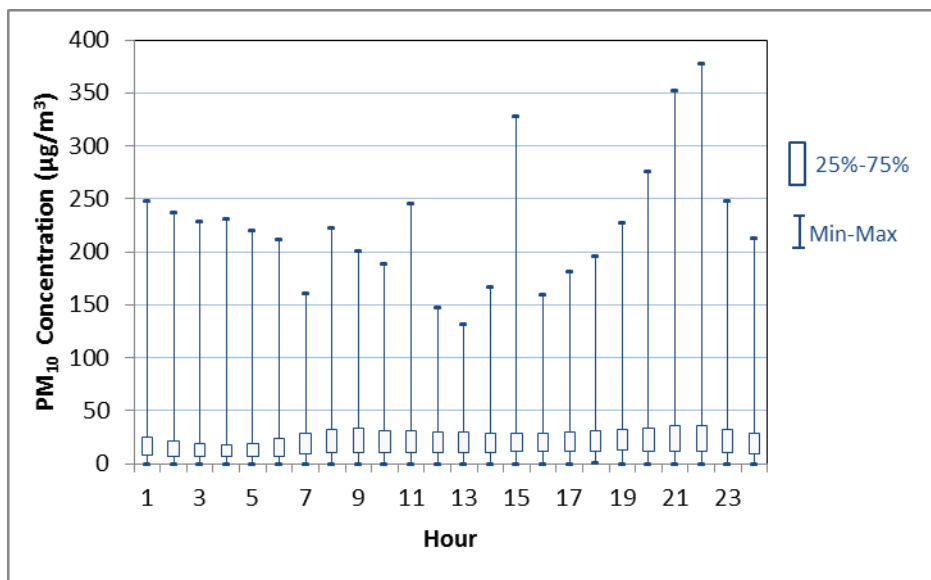


Figure E 4: Diurnal Variation of 1-Hour PM₁₀ Concentrations (µg/m³) at Edmonton Northwest



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PM_{2.5}

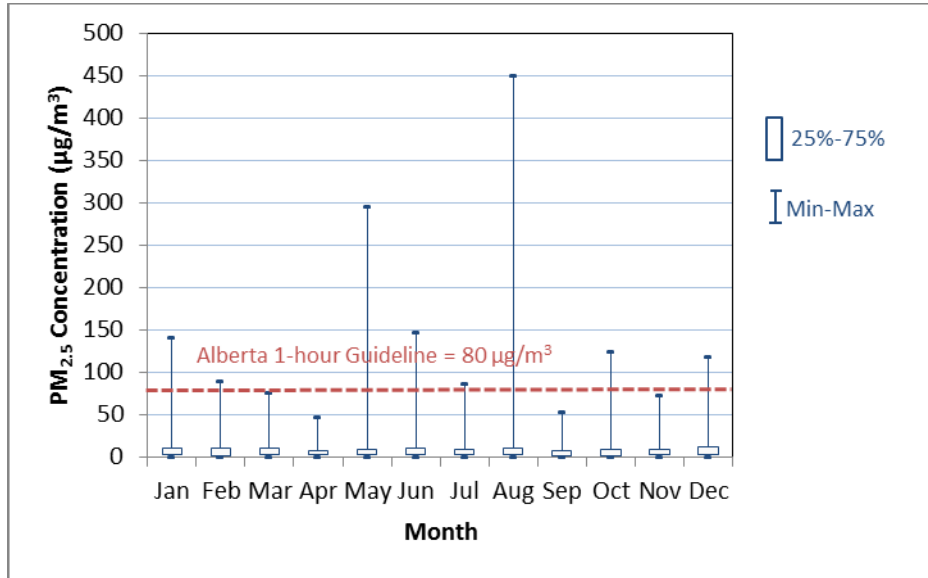


Figure E 5: Seasonal Variation of 1-Hour PM_{2.5} Concentrations (µg/m³) at Edmonton East

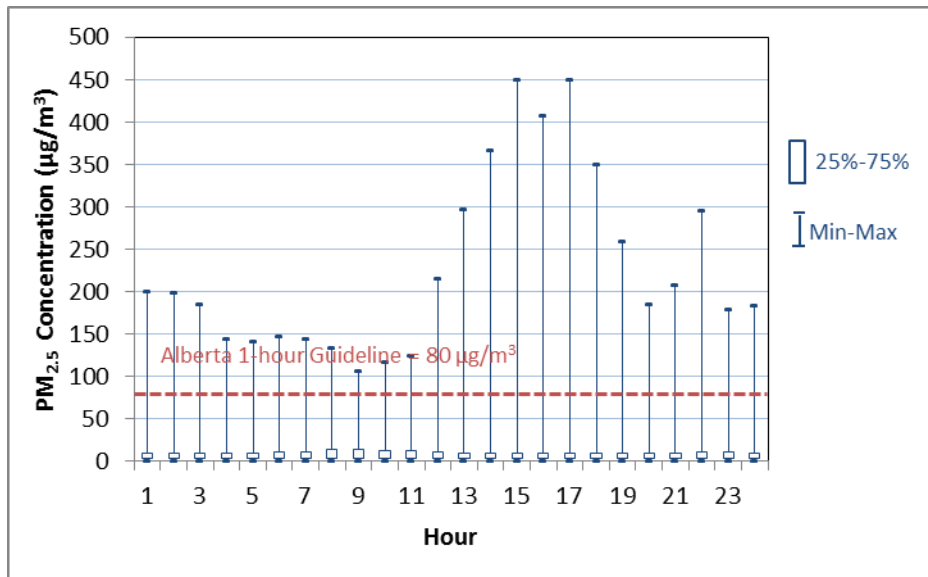


Figure E 6: Diurnal Variation of 1-Hour PM_{2.5} Concentrations (µg/m³) at Edmonton East



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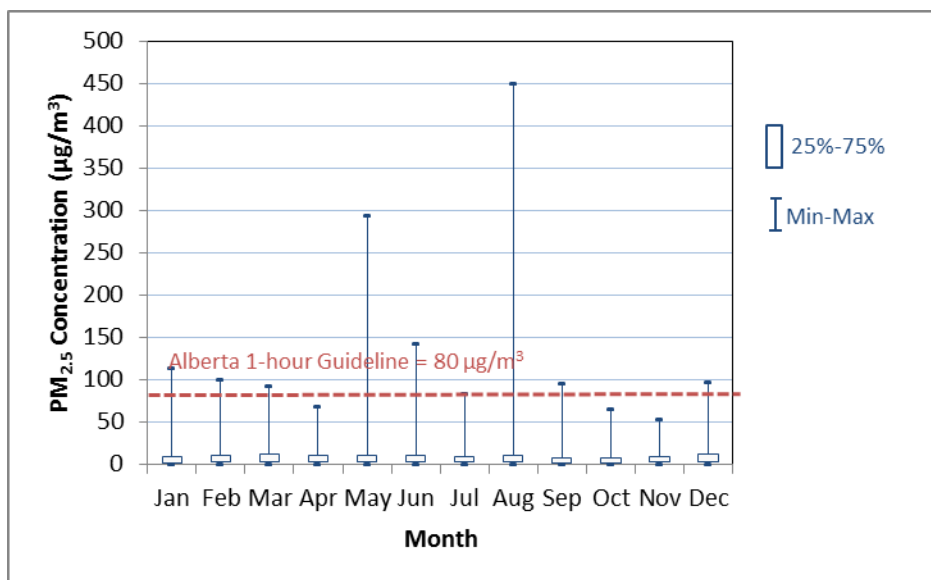


Figure E 7: Seasonal Variation of 1-Hour $PM_{2.5}$ Concentrations ($\mu\text{g}/\text{m}^3$) at Edmonton Central

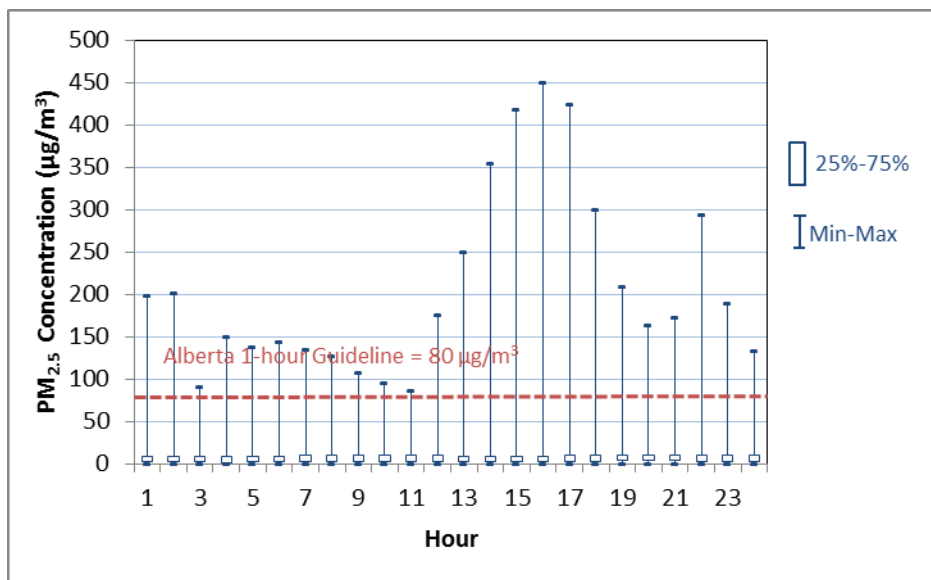


Figure E 8: Diurnal Variation of 1-Hour $PM_{2.5}$ Concentrations ($\mu\text{g}/\text{m}^3$) at Edmonton Central



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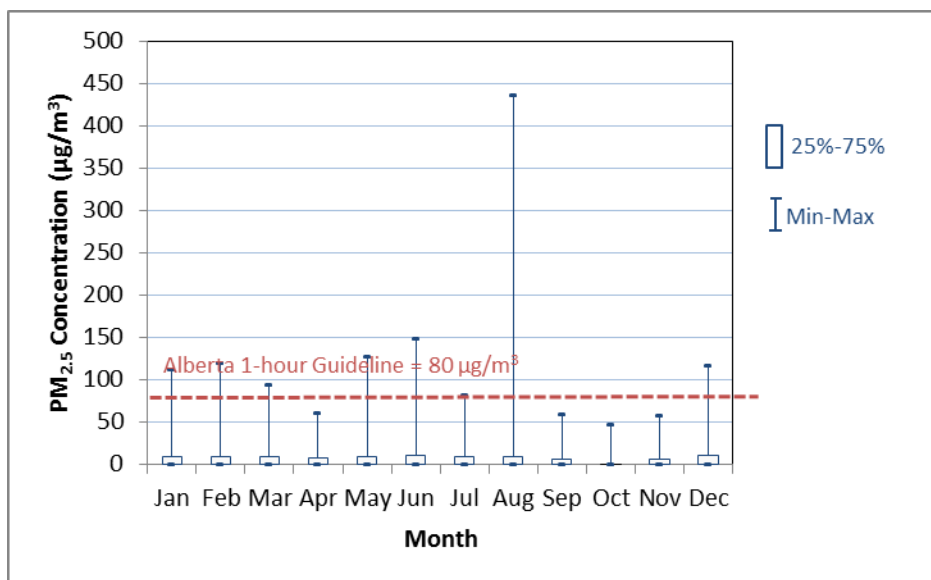


Figure E 9: Seasonal Variation of 1-Hour $PM_{2.5}$ Concentrations ($\mu g/m^3$) at Edmonton McIntyre

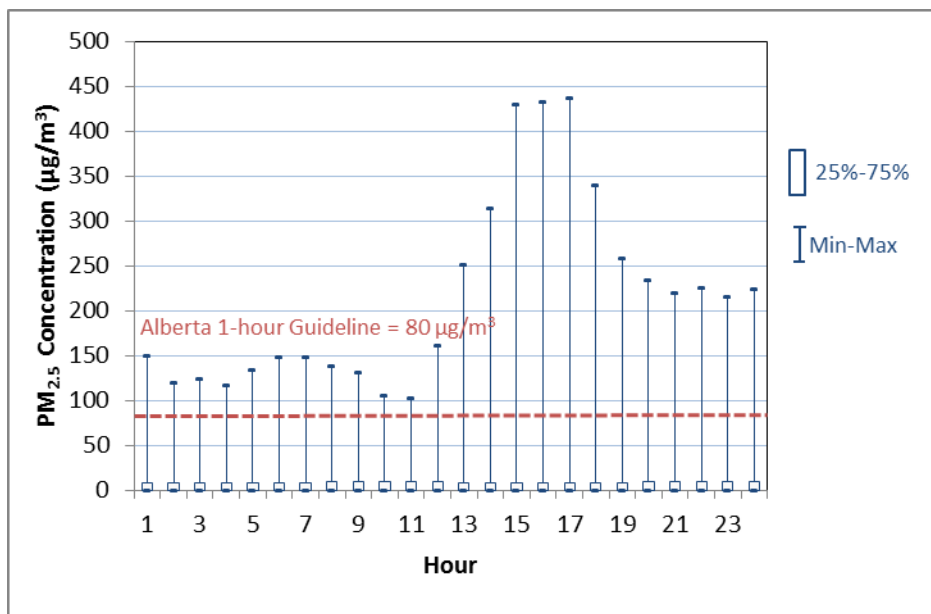


Figure E 10: Diurnal Variation of 1-Hour $PM_{2.5}$ Concentrations ($\mu g/m^3$) at Edmonton McIntyre



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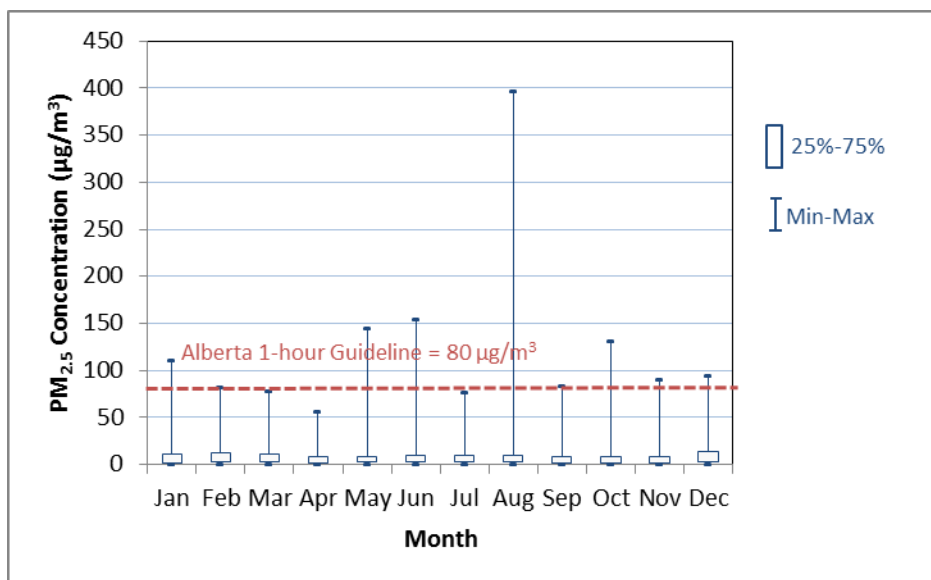


Figure E 11: Seasonal Variation of 1-Hour PM_{2.5} Concentrations (µg/m³) at Edmonton South

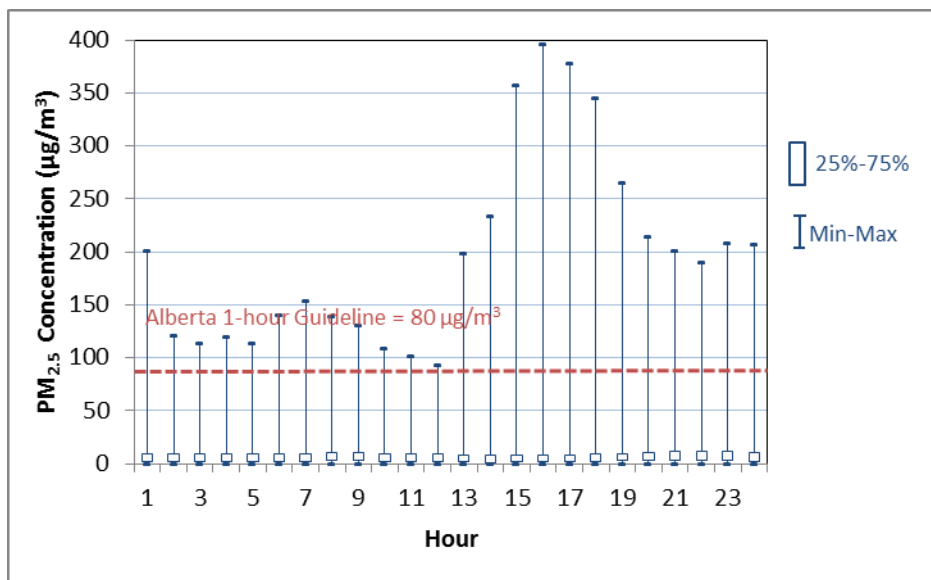


Figure E 12: Diurnal Variation of 1-Hour PM_{2.5} Concentrations (µg/m³) at Edmonton South

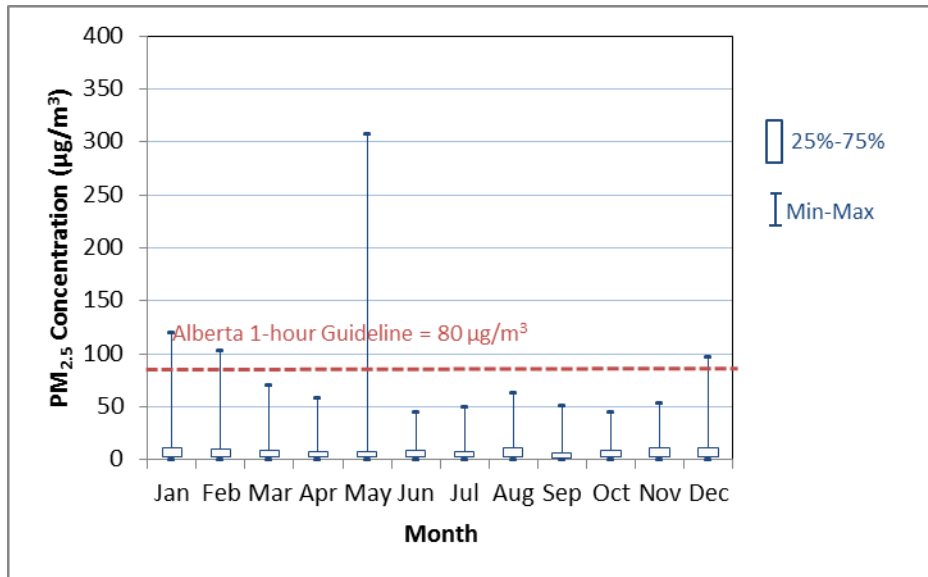


Figure E 13: Seasonal Variation of 1-Hour $PM_{2.5}$ Concentrations ($\mu\text{g}/\text{m}^3$) at Edmonton Northwest

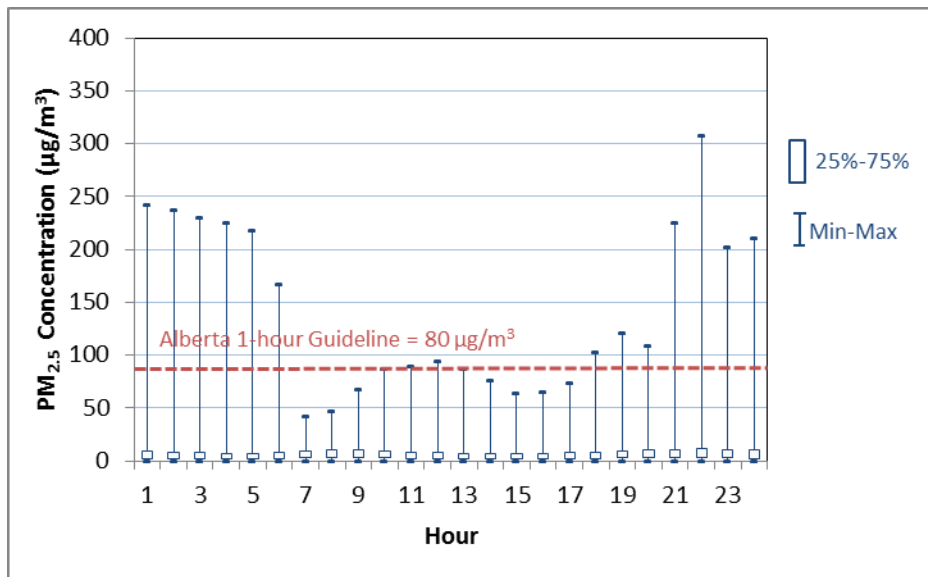


Figure E 14: Diurnal Variation of 1-Hour $PM_{2.5}$ Concentrations ($\mu\text{g}/\text{m}^3$) at Edmonton Northwest



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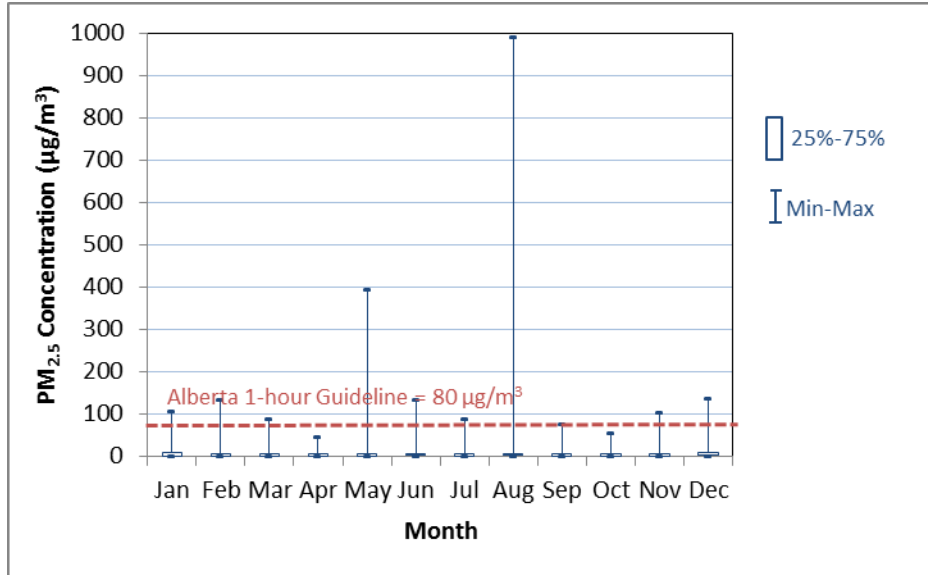


Figure E 15: Seasonal Variation of 1-Hour $PM_{2.5}$ Concentrations ($\mu\text{g}/\text{m}^3$) at Fort Saskatchewan

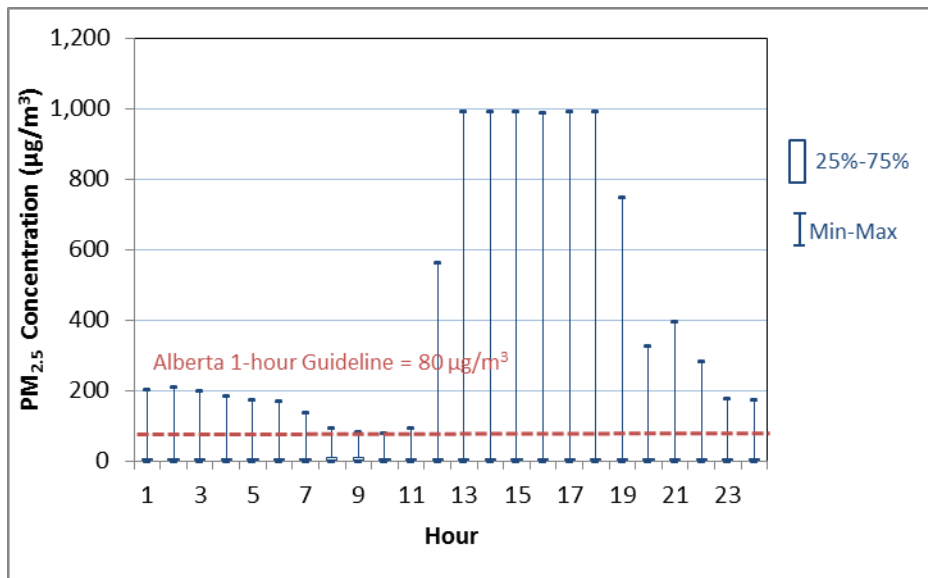


Figure E 16: Diurnal Variation of 1-Hour $PM_{2.5}$ Concentrations ($\mu\text{g}/\text{m}^3$) at Fort Saskatchewan



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CO

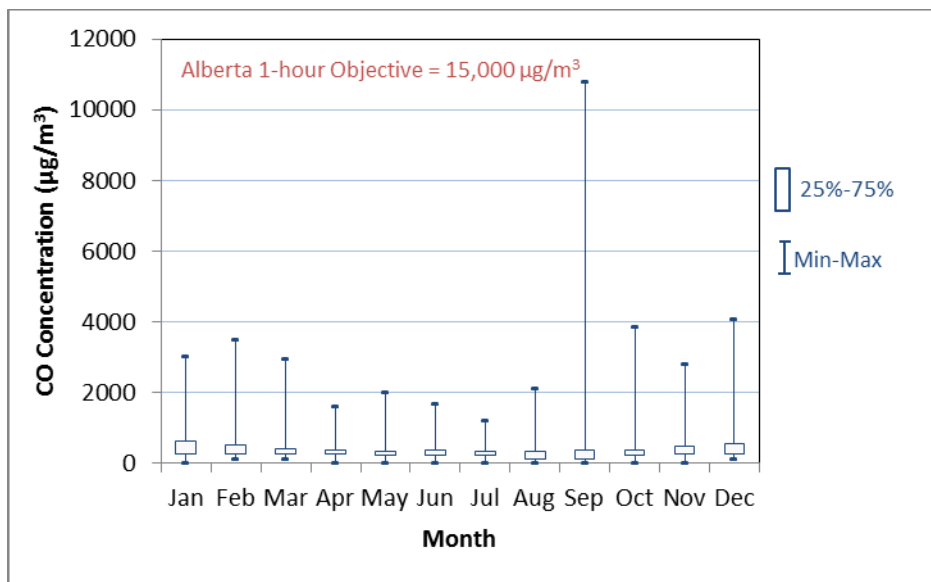


Figure E 17: Seasonal Variation of 1-Hour CO Concentrations ($\mu\text{g}/\text{m}^3$) at Edmonton East

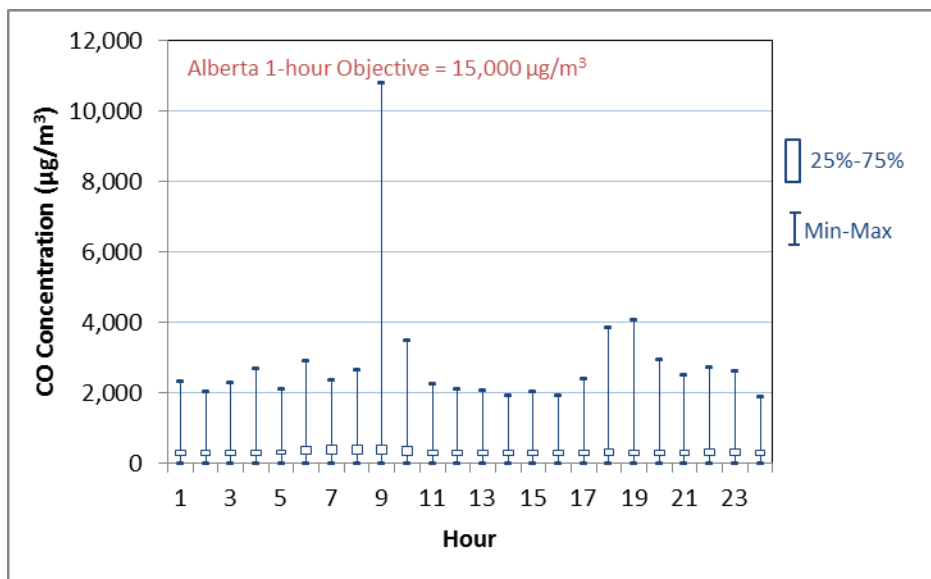


Figure E 18: Diurnal Variation of 1-Hour CO Concentrations ($\mu\text{g}/\text{m}^3$) at Edmonton East

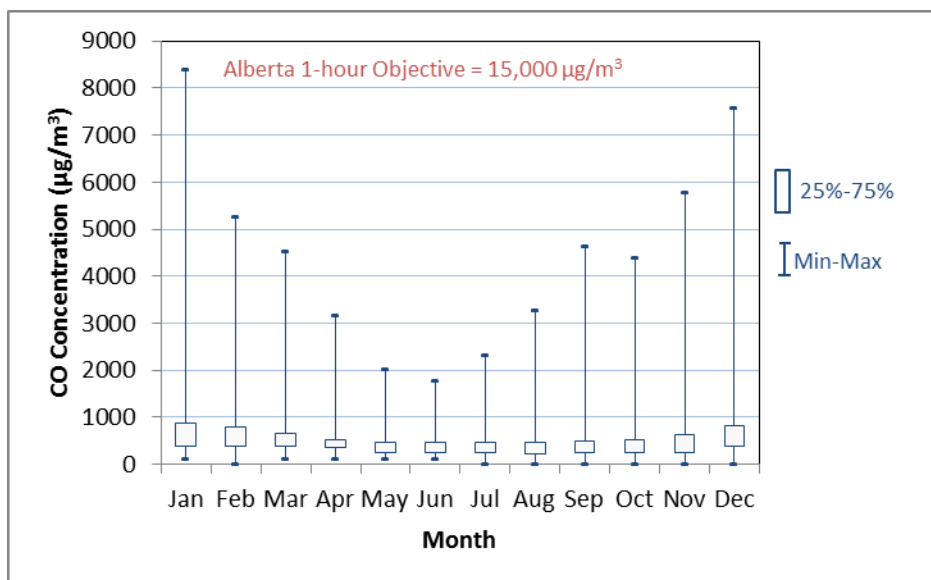


Figure E 19: Seasonal Variation of 1-Hour CO Concentrations ($\mu\text{g}/\text{m}^3$) at Edmonton Central

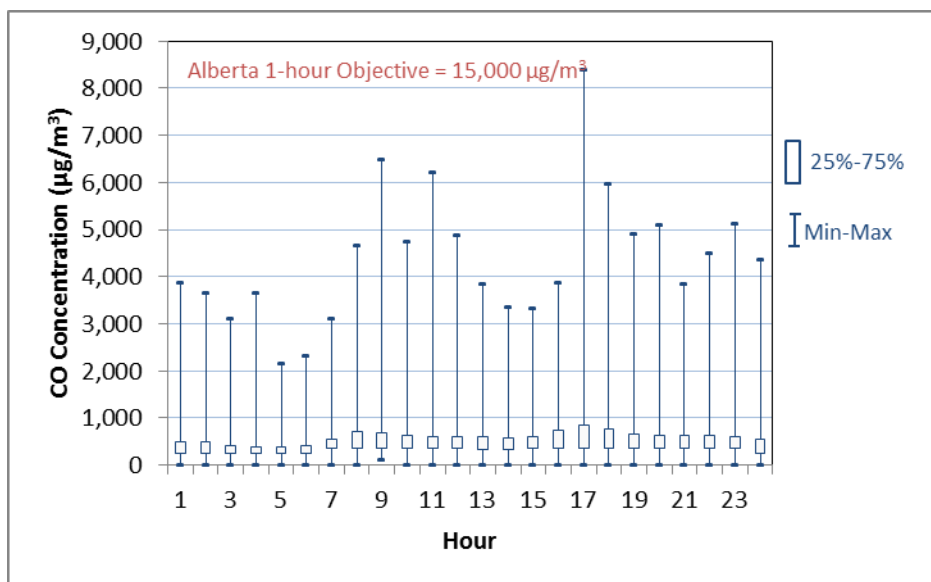


Figure E 20: Diurnal Variation of 1-Hour CO Concentrations ($\mu\text{g}/\text{m}^3$) at Edmonton Central

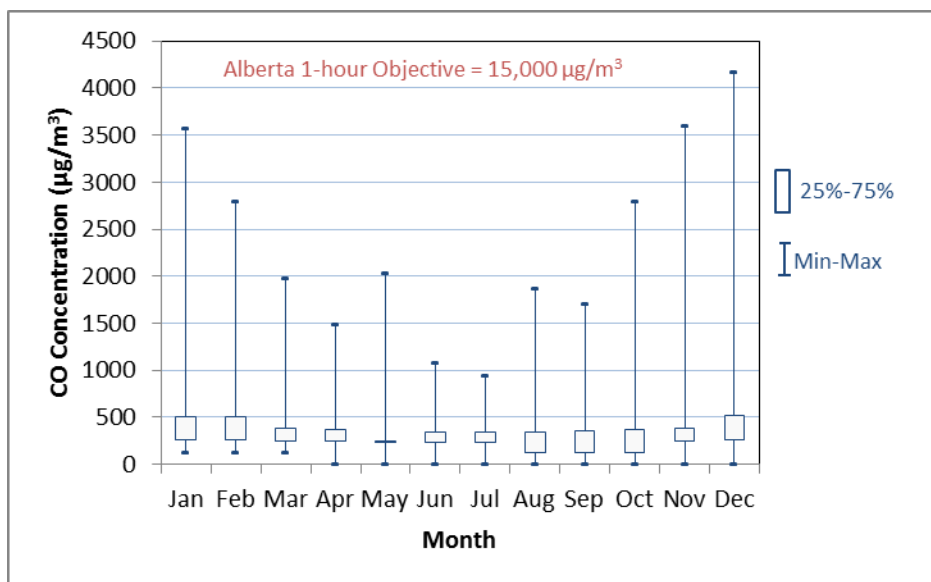


Figure E 21: Seasonal Variation of 1-Hour CO Concentrations ($\mu\text{g}/\text{m}^3$) at Edmonton South

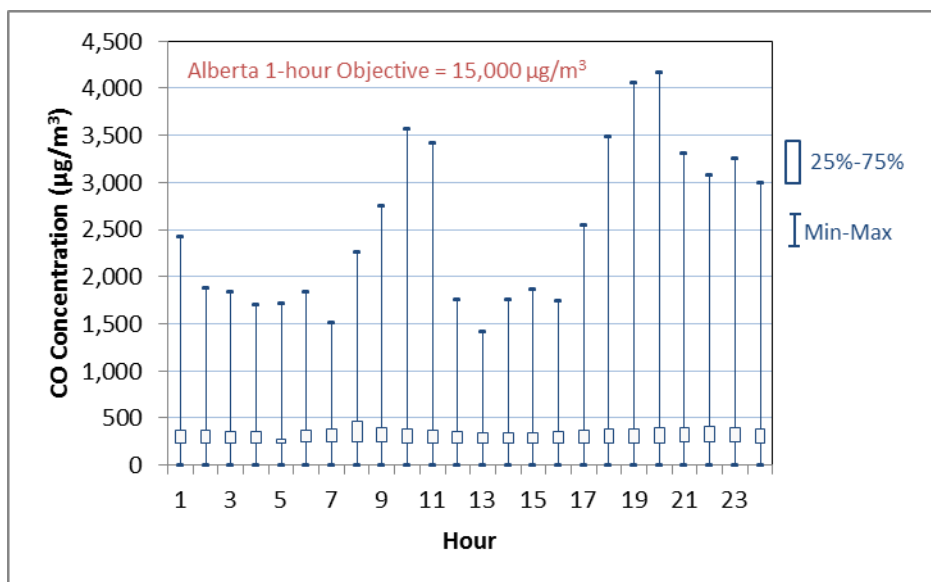


Figure E 22: Diurnal Variation of 1-Hour CO Concentrations ($\mu\text{g}/\text{m}^3$) at Edmonton South

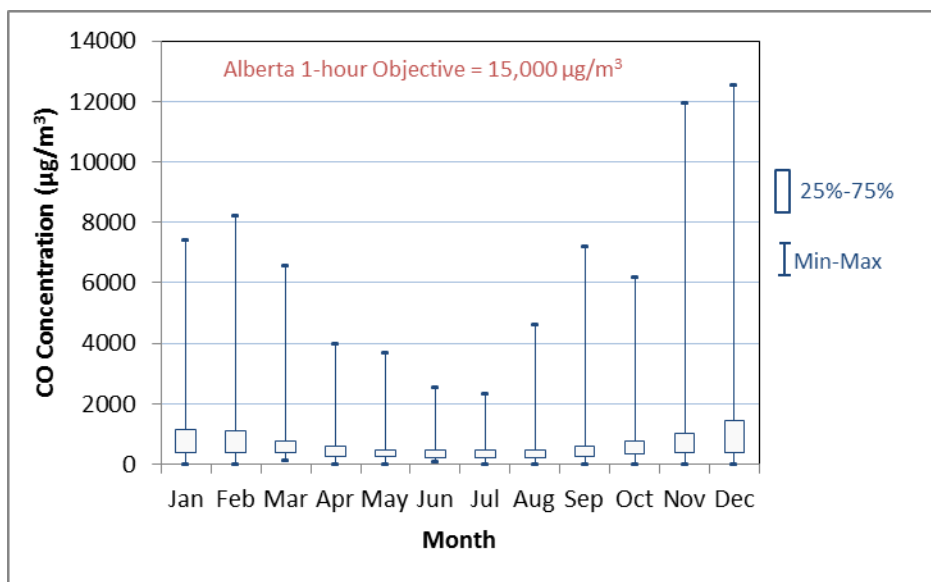


Figure E 23: Seasonal Variation of 1-Hour CO Concentrations ($\mu\text{g}/\text{m}^3$) at Edmonton Northwest

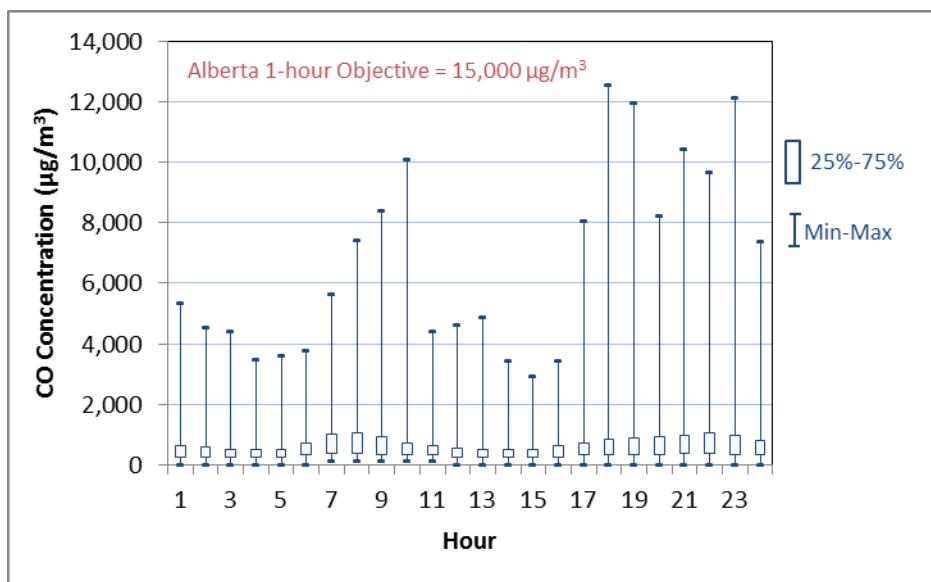


Figure E 24: Diurnal Variation of 1-Hour CO Concentrations ($\mu\text{g}/\text{m}^3$) at Edmonton Northwest

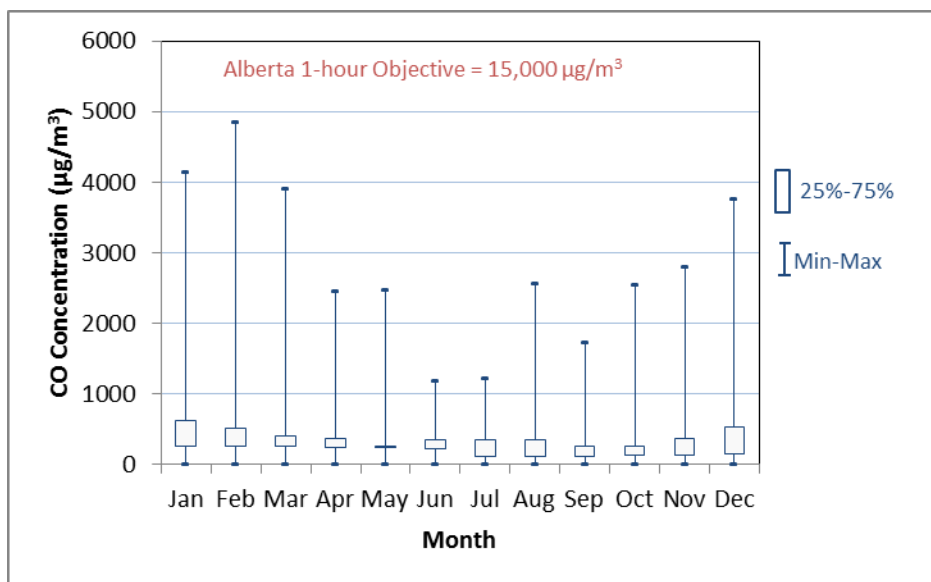


Figure E 25: Seasonal Variation of 1-Hour CO Concentrations ($\mu\text{g}/\text{m}^3$) at Fort Saskatchewan

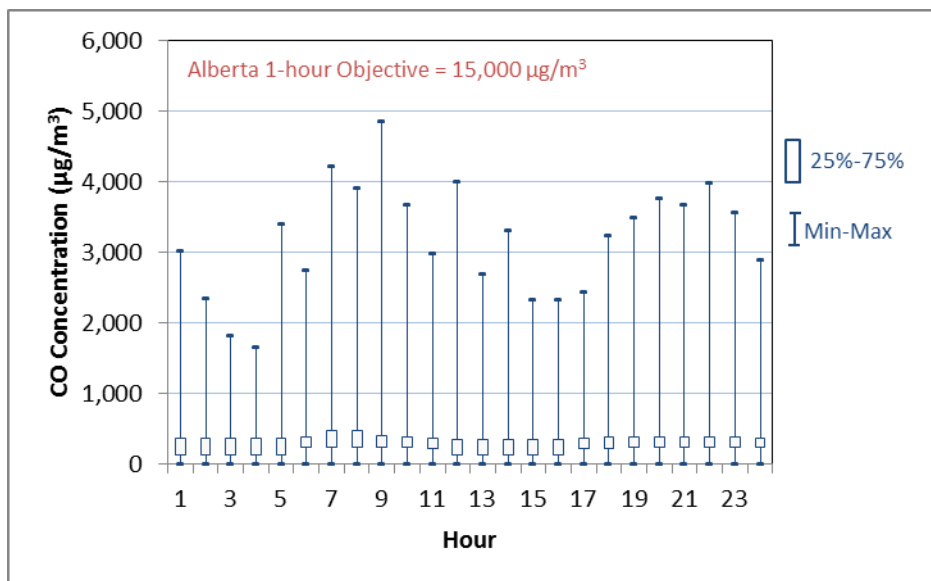


Figure E 26: Diurnal Variation of 1-Hour CO Concentrations ($\mu\text{g}/\text{m}^3$) at Fort Saskatchewan

NO₂

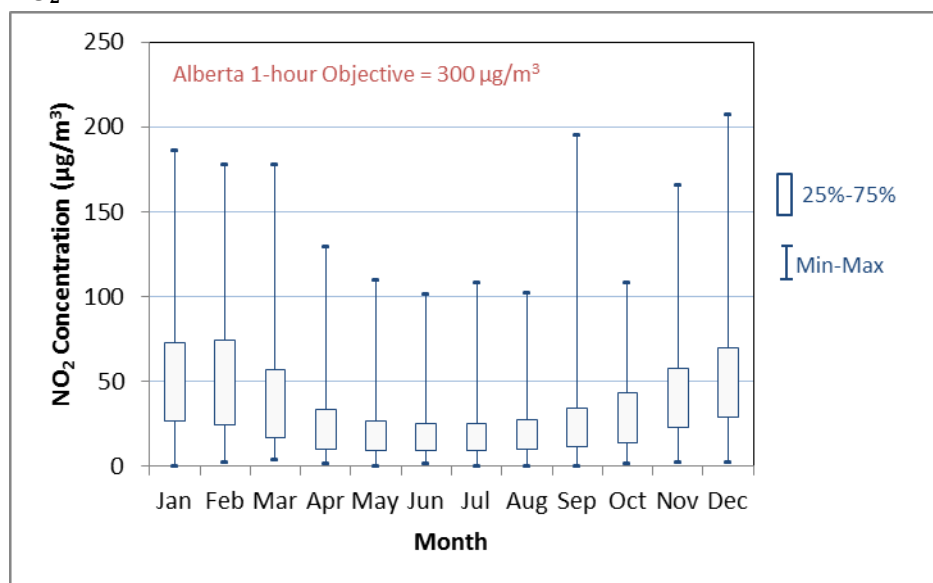


Figure E 27: Seasonal Variation of 1-Hour NO₂ Concentrations (µg/m³) at Edmonton East

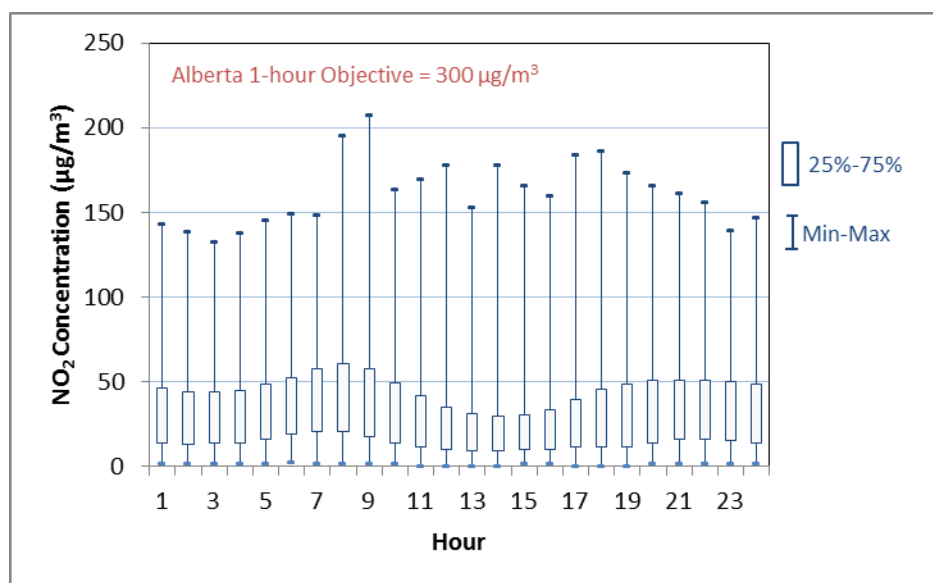


Figure E 28: Diurnal Variation of 1-Hour NO₂ Concentrations (µg/m³) at Edmonton East

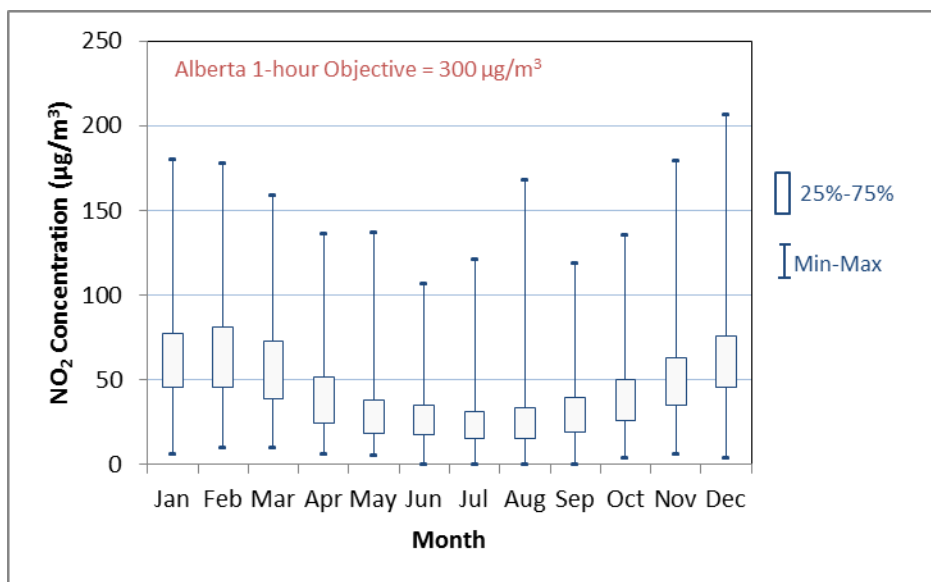


Figure E 29: Seasonal Variation of 1-Hour NO₂ Concentrations ($\mu\text{g}/\text{m}^3$) at Edmonton Central

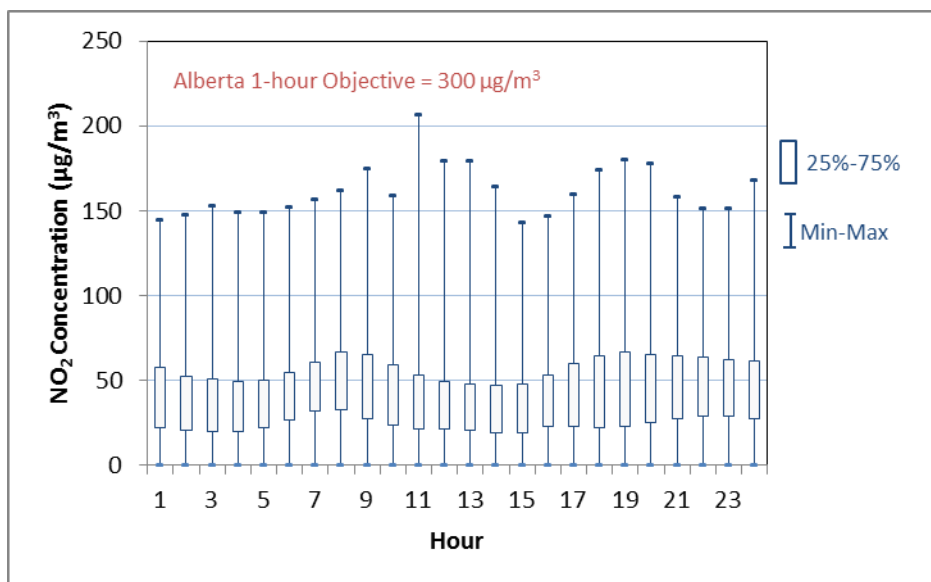


Figure E 30: Diurnal Variation of 1-Hour NO₂ Concentrations ($\mu\text{g}/\text{m}^3$) at Edmonton Central

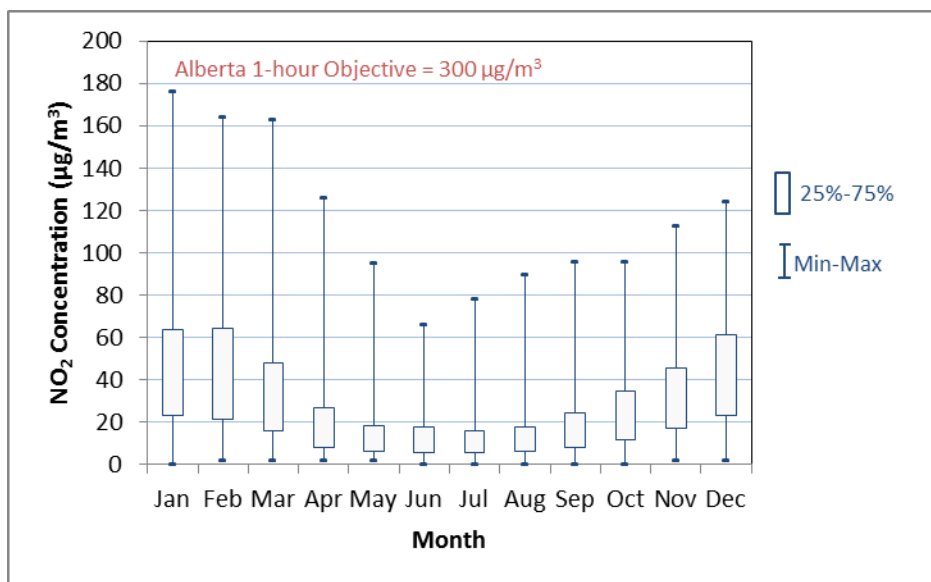


Figure E 31: Seasonal Variation of 1-Hour NO₂ Concentrations (µg/m³) at Edmonton South

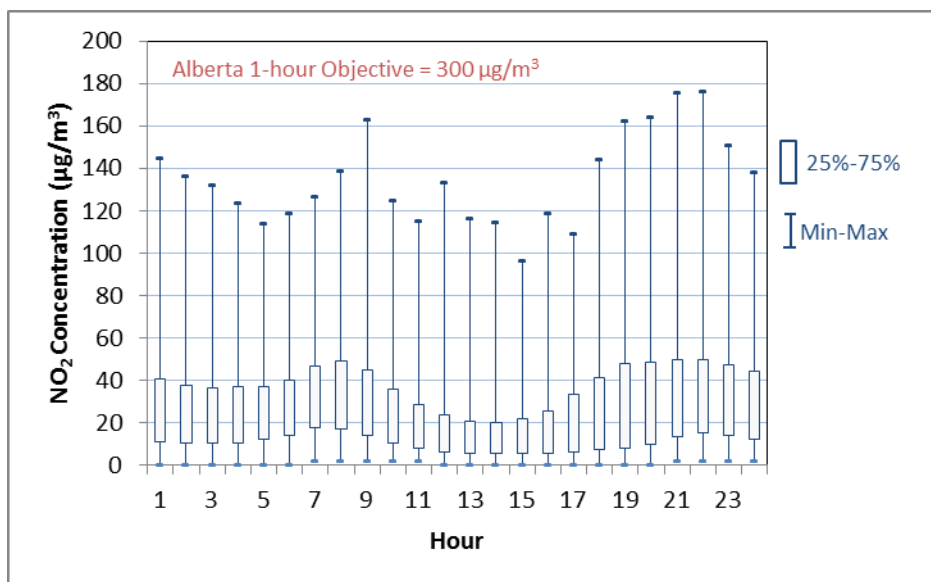


Figure E 32: Diurnal Variation of 1-Hour NO₂ Concentrations (µg/m³) at Edmonton South

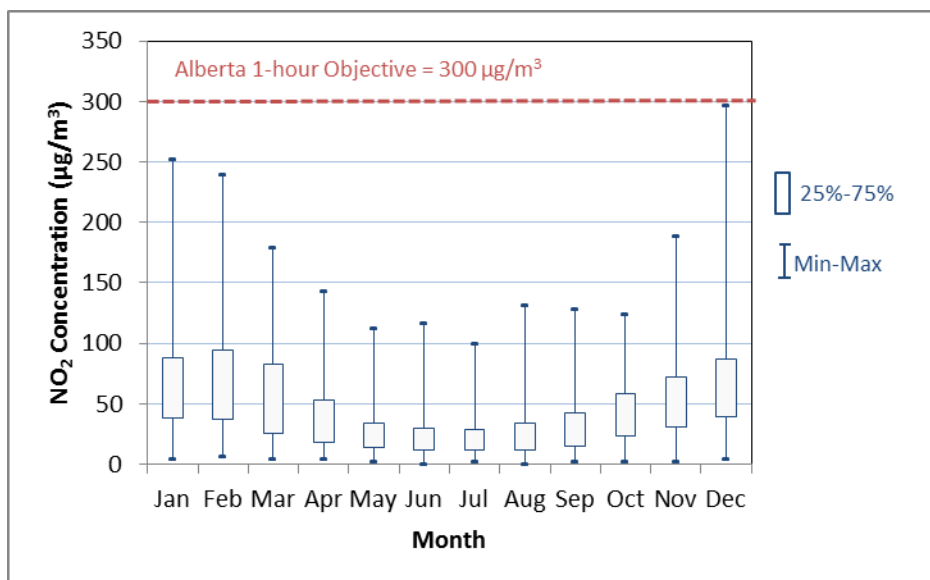


Figure E 33: Seasonal Variation of 1-Hour NO₂ Concentrations ($\mu\text{g}/\text{m}^3$) at Edmonton Northwest

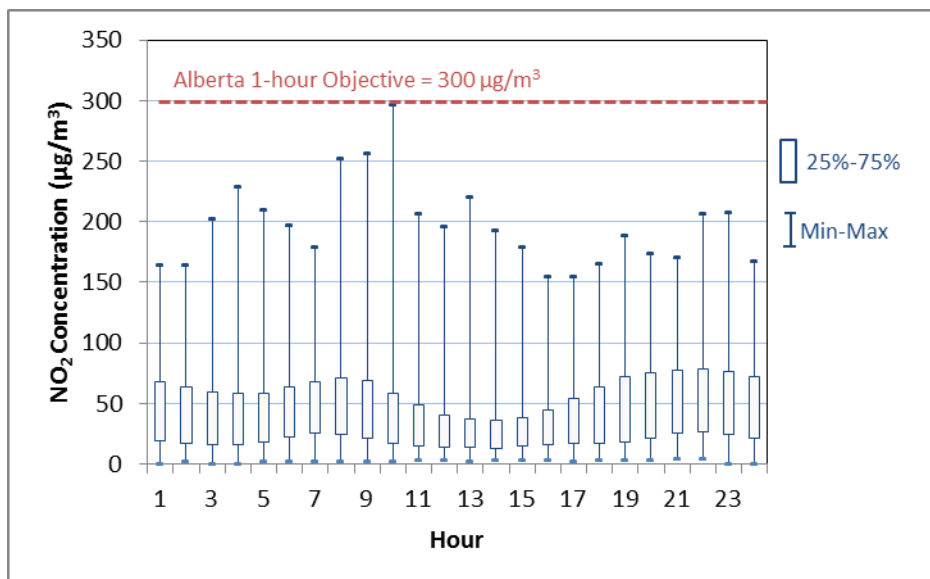


Figure E 34: Diurnal Variation of 1-Hour NO₂ Concentrations ($\mu\text{g}/\text{m}^3$) at Edmonton Northwest



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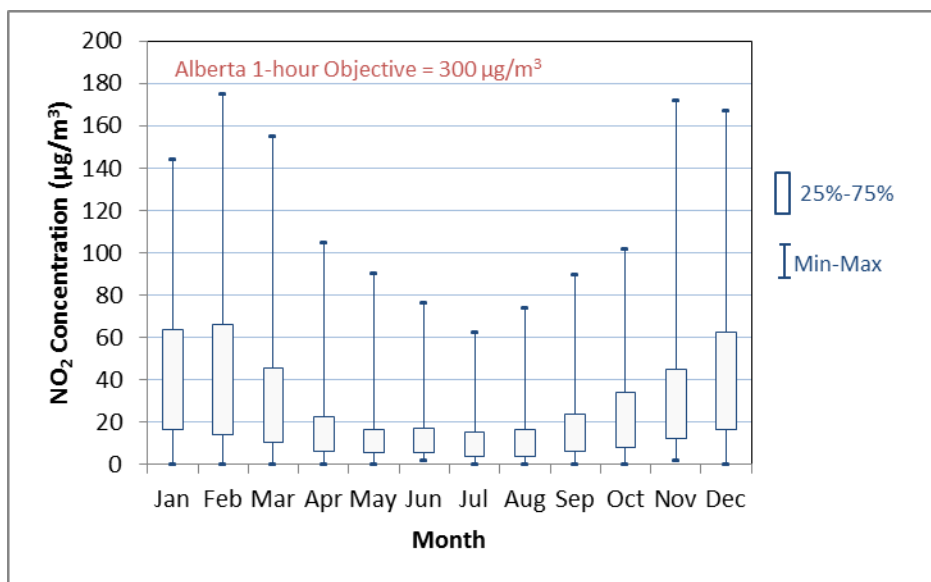


Figure E 35: Seasonal Variation of 1-Hour NO₂ Concentrations ($\mu\text{g}/\text{m}^3$) at Fort Saskatchewan

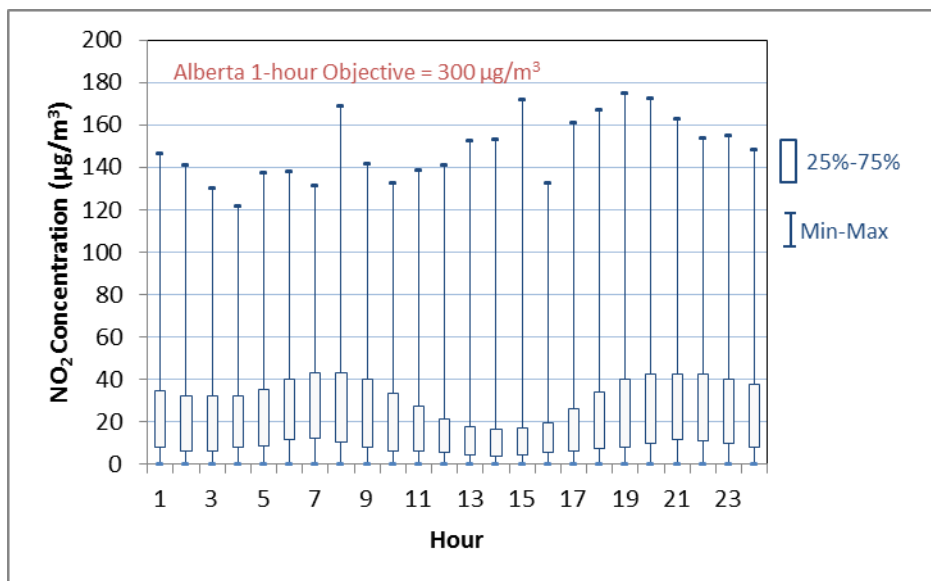


Figure E 36: Diurnal Variation of 1-Hour NO₂ Concentrations ($\mu\text{g}/\text{m}^3$) at Fort Saskatchewan

SO₂

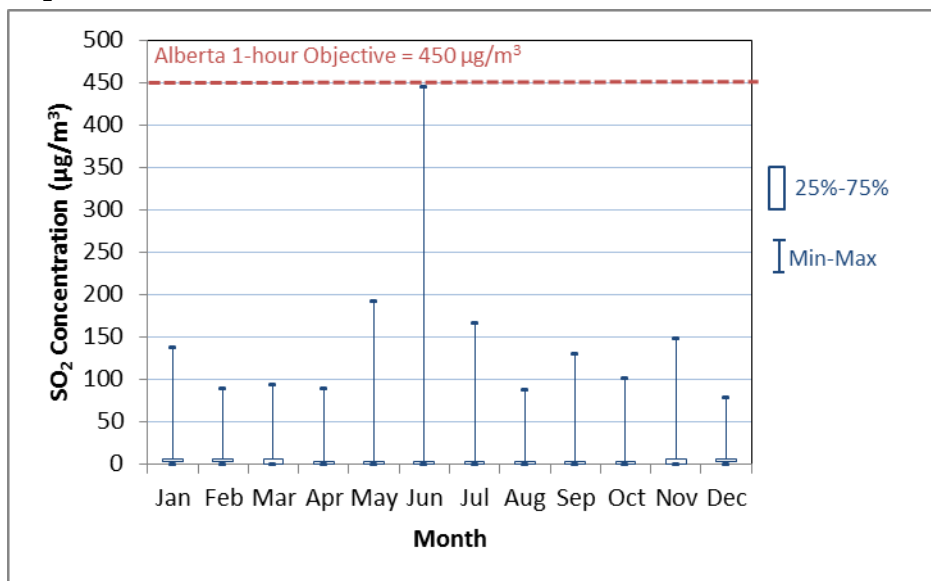


Figure E 37: Seasonal Variation of 1-Hour SO₂ Concentrations (µg/m³) at Edmonton East

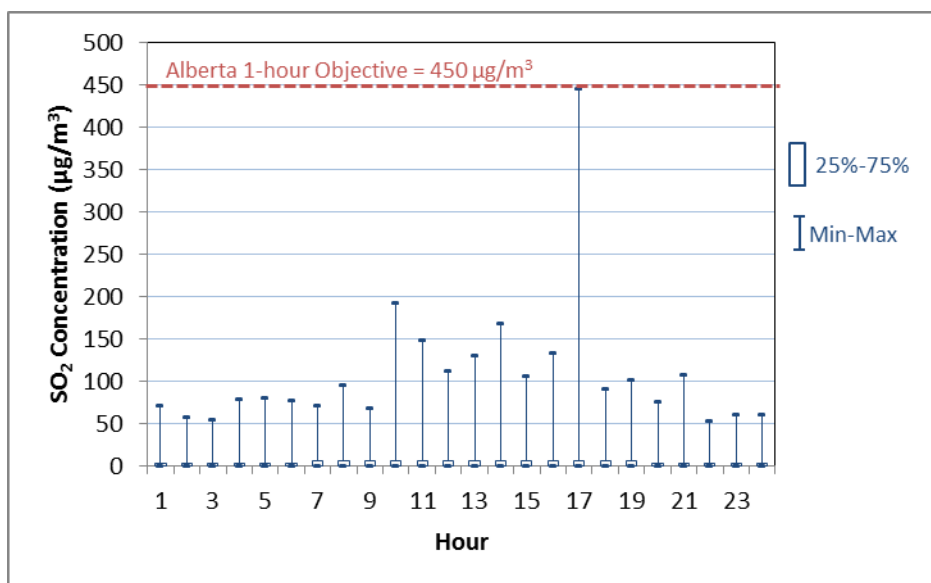


Figure E 38: Diurnal Variation of 1-Hour SO₂ Concentrations (µg/m³) at Edmonton East

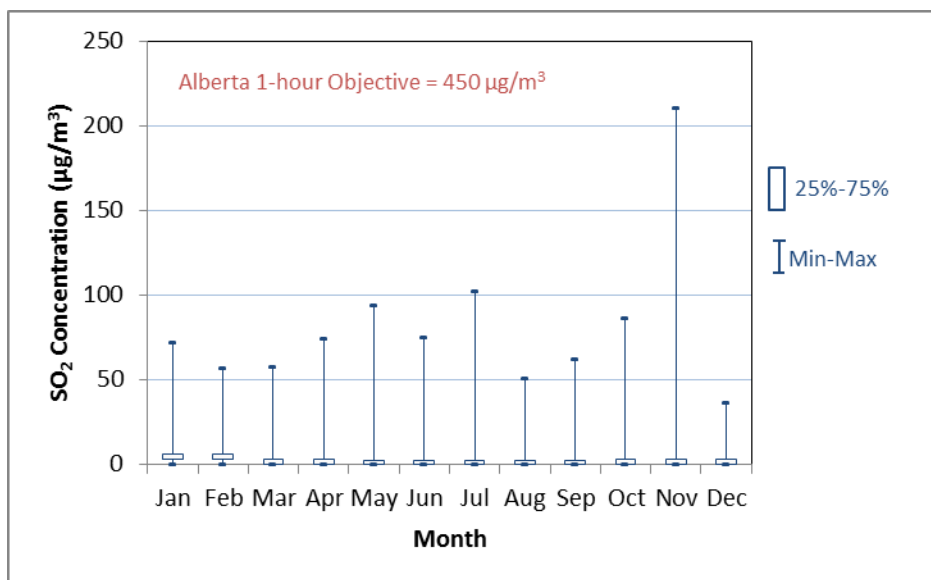


Figure E 39: Seasonal Variation of 1-Hour SO₂ Concentrations (µg/m³) at Edmonton South

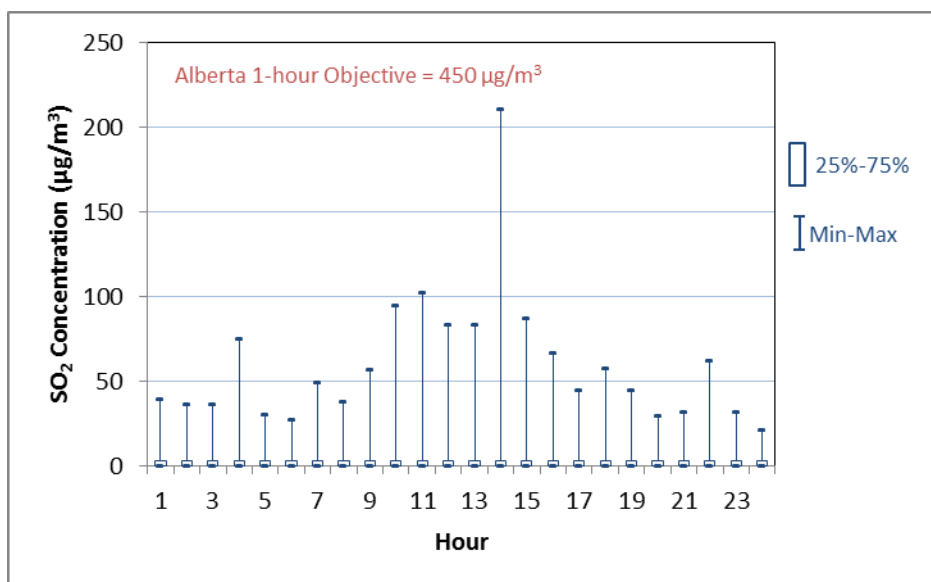


Figure E 40: Diurnal Variation of 1-Hour SO₂ Concentrations (µg/m³) at Edmonton South

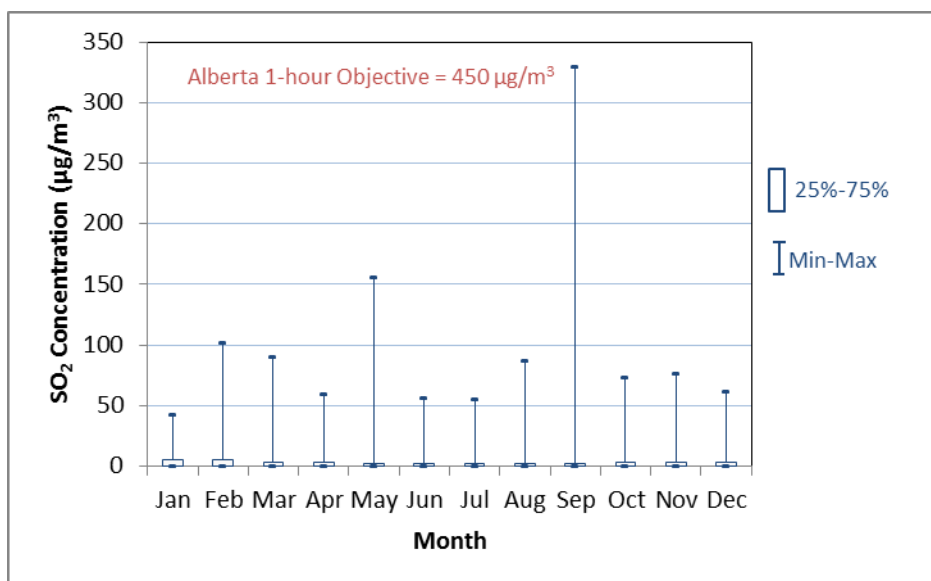


Figure E 41: Seasonal Variation of 1-Hour SO₂ Concentrations (µg/m³) at Fort Saskatchewan

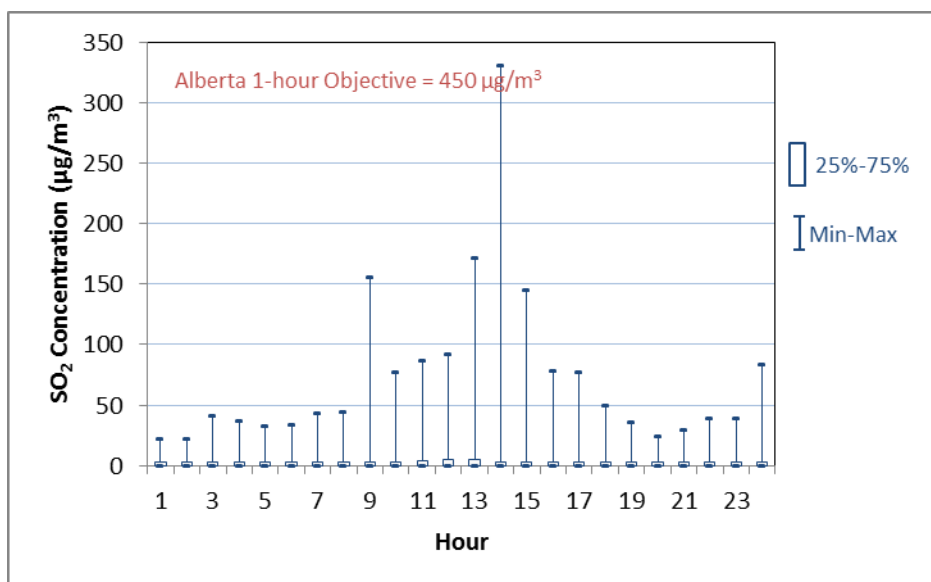


Figure E 42: Diurnal Variation of 1-Hour SO₂ Concentrations (µg/m³) at Fort Saskatchewan

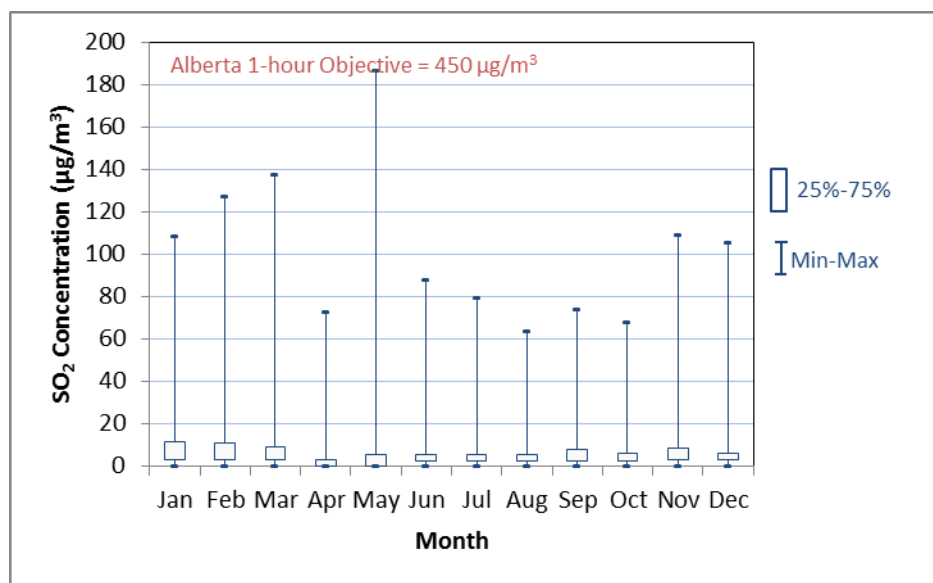


Figure E 43: Seasonal Variation of 1-Hour SO₂ Concentrations (µg/m³) at Sherwood Park

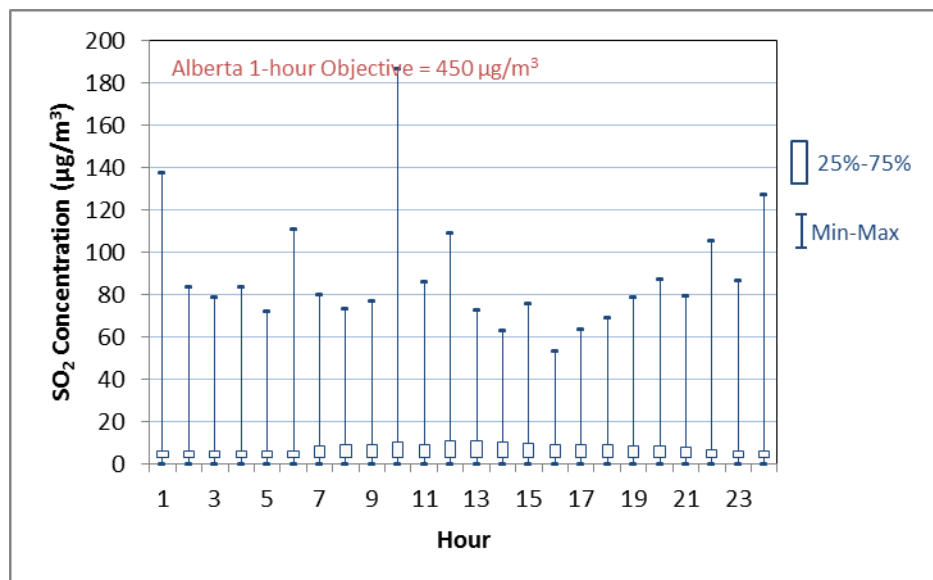


Figure E 44: Diurnal Variation of 1-Hour SO₂ Concentrations (µg/m³) at Sherwood Park



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Gainford Area

PM₁₀

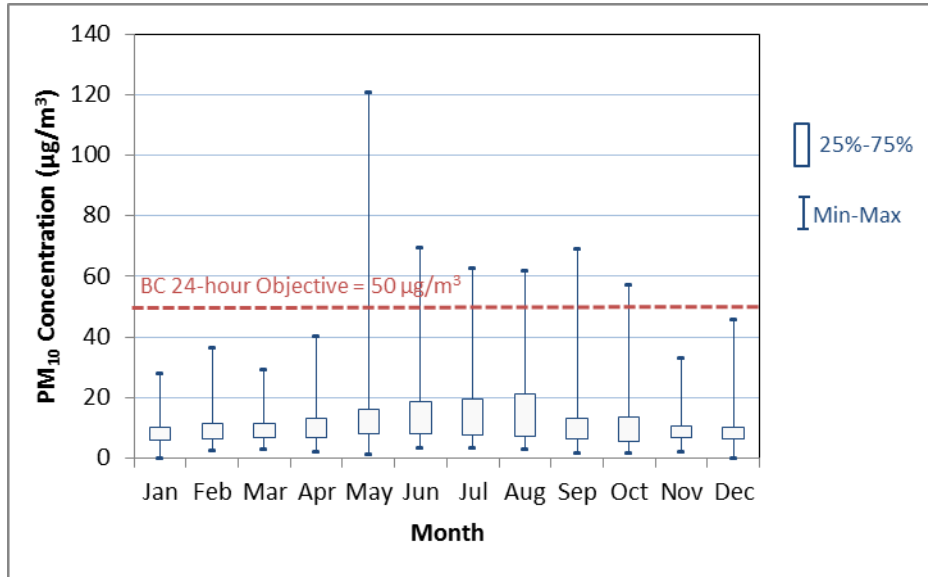


Figure E 45: Seasonal Variation of 24-hour PM₁₀ Concentrations ($\mu\text{g}/\text{m}^3$) at Tomahawk

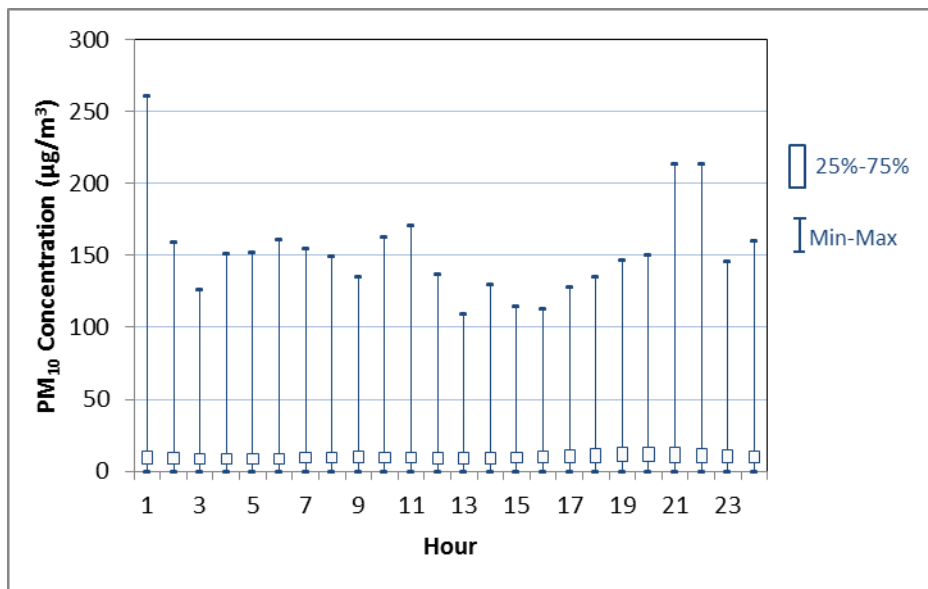


Figure E 46: Diurnal Variation of 1-Hour PM₁₀ Concentrations ($\mu\text{g}/\text{m}^3$) at Tomahawk



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PM_{2.5}

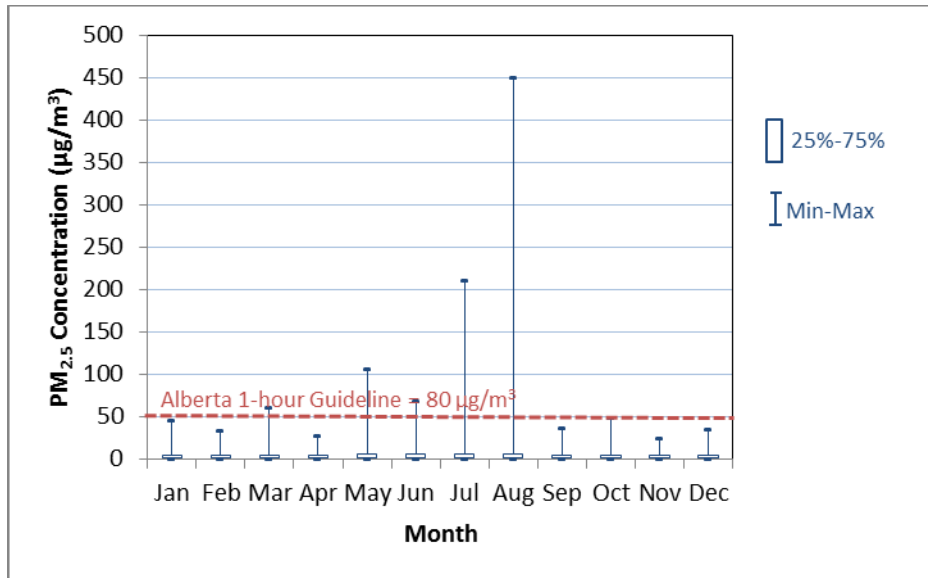


Figure E 47: Seasonal Variation of 1-hour PM_{2.5} Concentrations (µg/m³) at Power

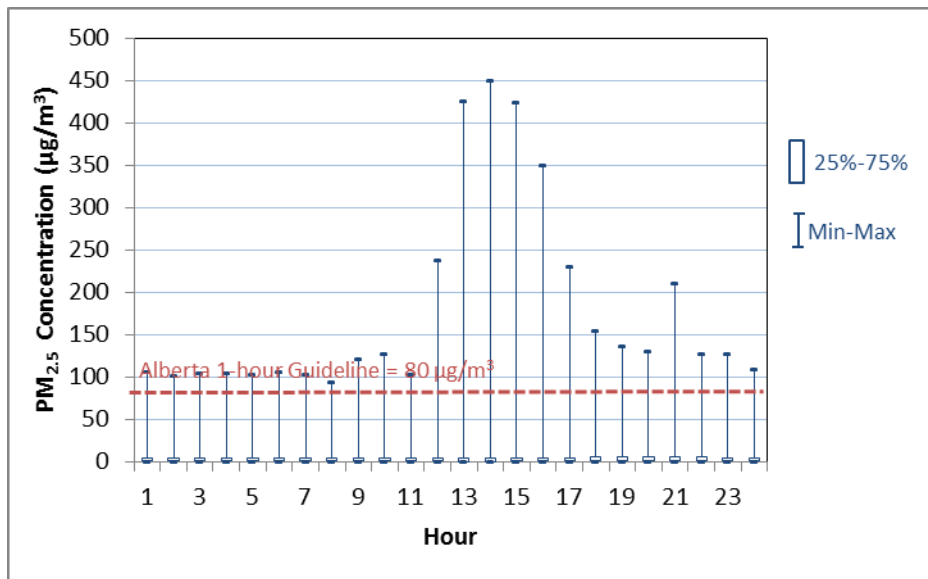


Figure E 48: Diurnal Variation of 1-Hour PM_{2.5} Concentrations (µg/m³) at Power



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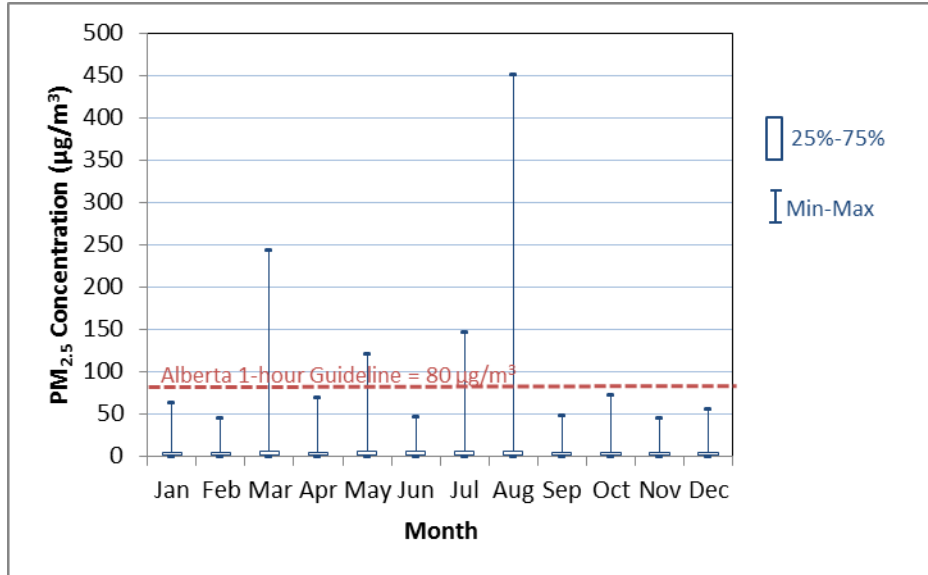


Figure E 49: Seasonal Variation of 1-hour $PM_{2.5}$ Concentrations ($\mu g/m^3$) at Tomahawk

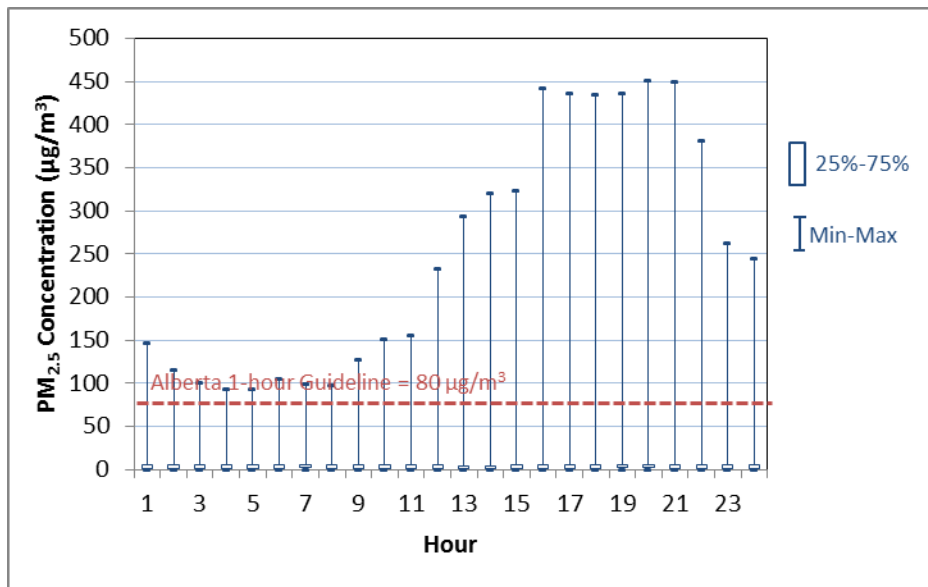


Figure E 50: Diurnal Variation of 1-Hour $PM_{2.5}$ Concentrations ($\mu g/m^3$) at Tomahawk



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NO₂

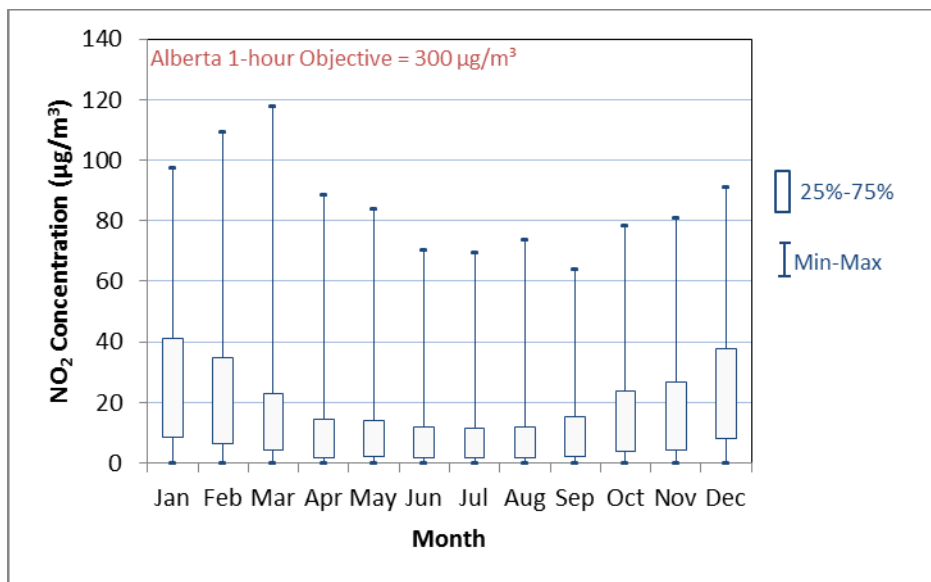
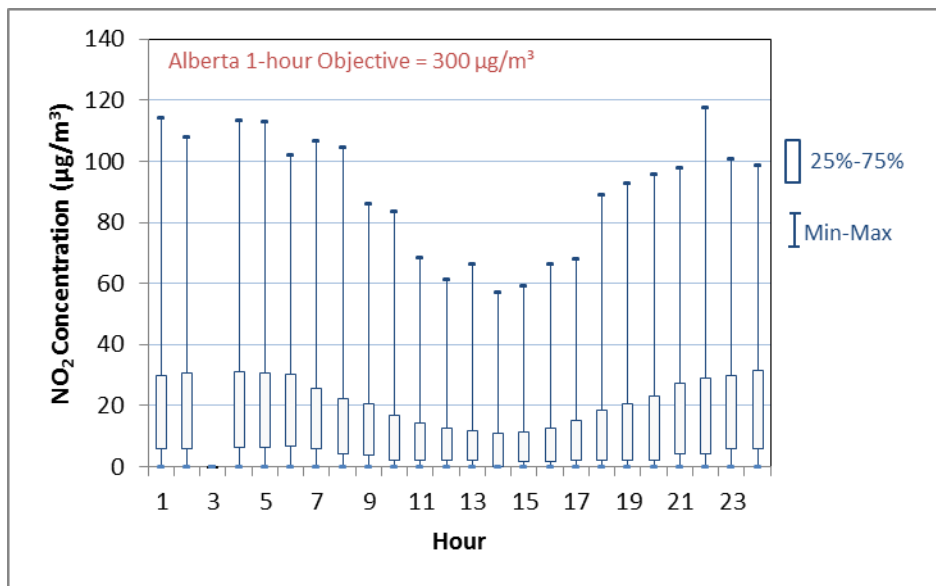


Figure E 51: Seasonal Variation of 1-hour NO₂ Concentrations (µg/m³) at Meadows



Note: Daily instrumental zero/span occurred at 03:00 for the majority of the sampling period and therefore there are limited measurement data at 03:00.

Figure E 52: Diurnal Variation of 1-Hour NO₂ Concentrations (µg/m³) at Meadows



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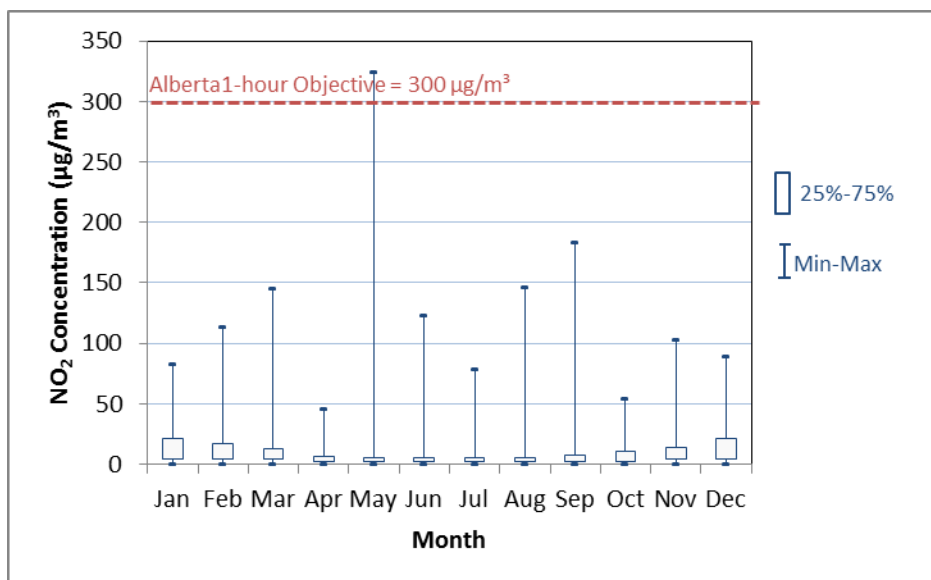


Figure E 53: Seasonal Variation of 1-hour NO₂ Concentrations (µg/m³) at Power

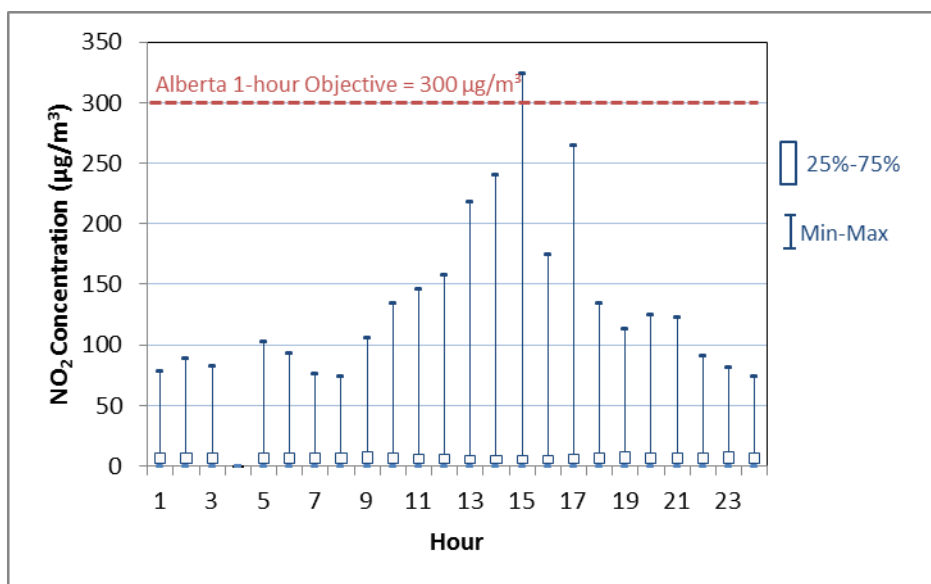


Figure E 54: Diurnal Variation of 1-Hour NO₂ Concentrations (µg/m³) at Power

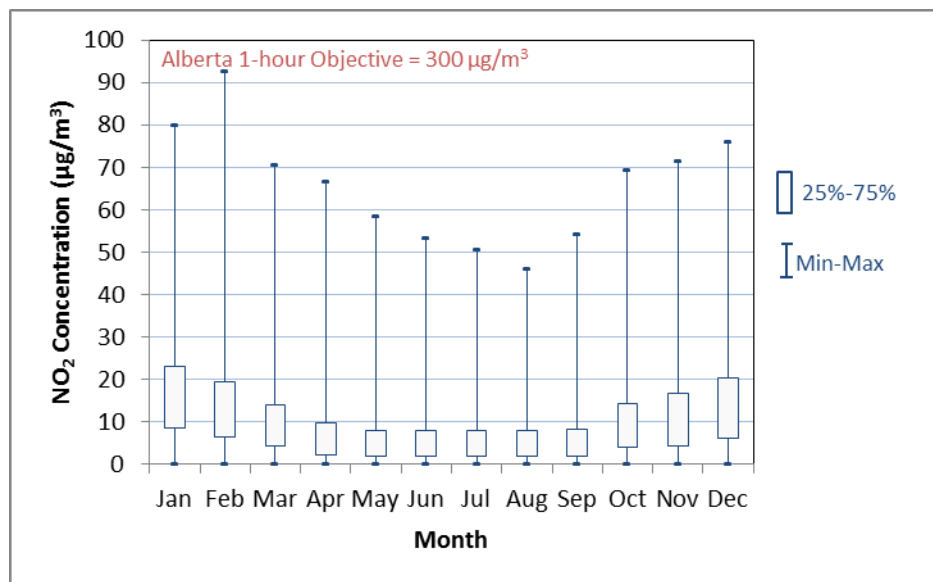
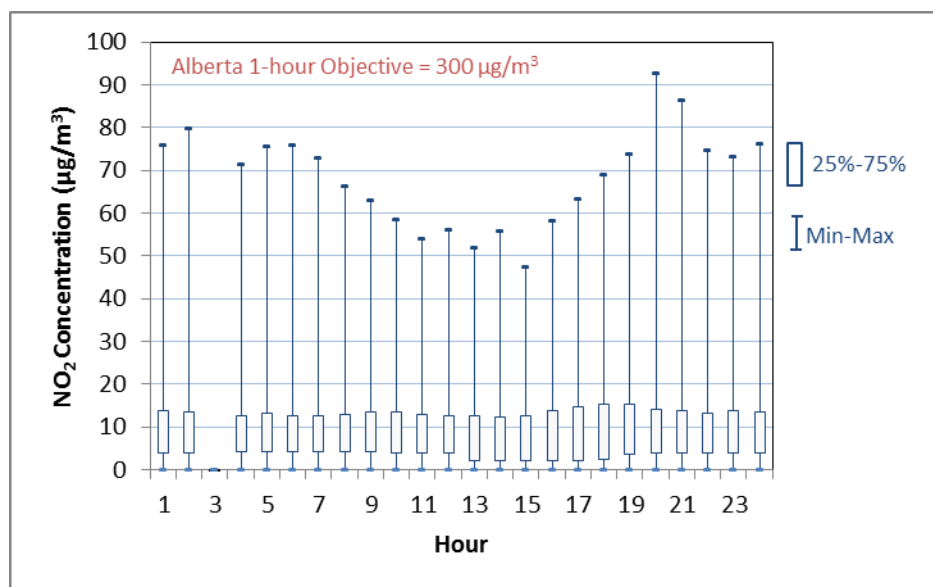


Figure E 55: Seasonal Variation of 1-hour NO₂ Concentrations (µg/m³) at Wagner



Note: Daily instrumental zero/span occurred at 03:00 for the majority of the sampling period and therefore there are limited measurement data at 03:00.

Figure E 56: Diurnal Variation of 1-Hour NO₂ Concentrations (µg/m³) at Wagner

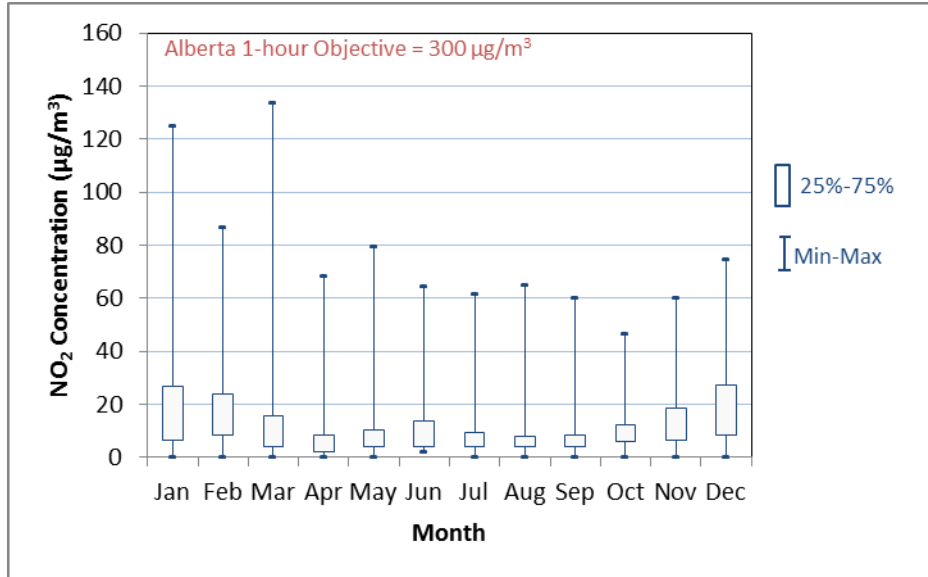
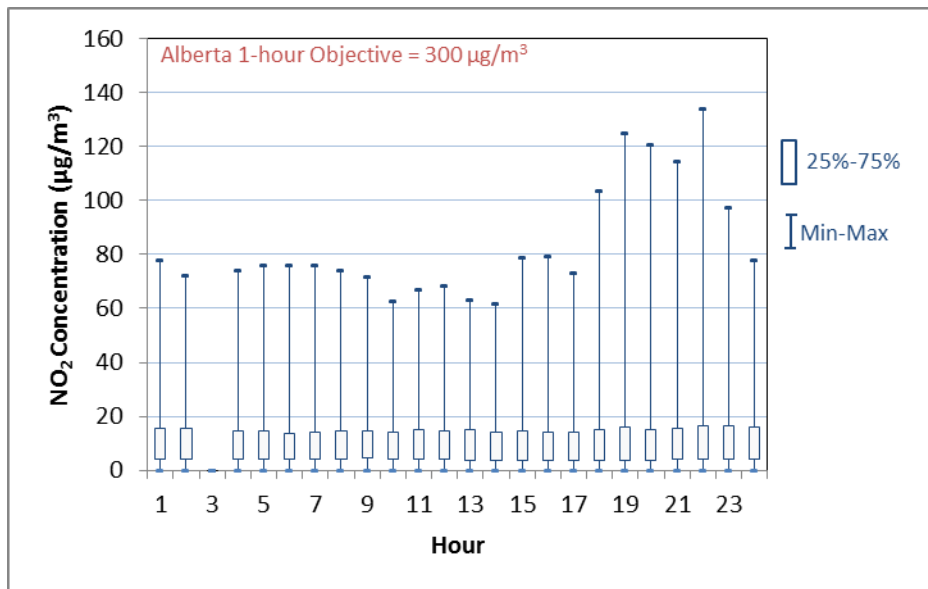


Figure E 57: Seasonal Variation of 1-hour NO₂ Concentrations (µg/m³) at Wagner 2



Note: Daily instrumental zero/span occurred at 03:00 for the majority of the sampling period and therefore there are limited measurement data at 03:00.

Figure E 58: Diurnal Variation of 1-Hour NO₂ Concentrations (µg/m³) at Wagner 2



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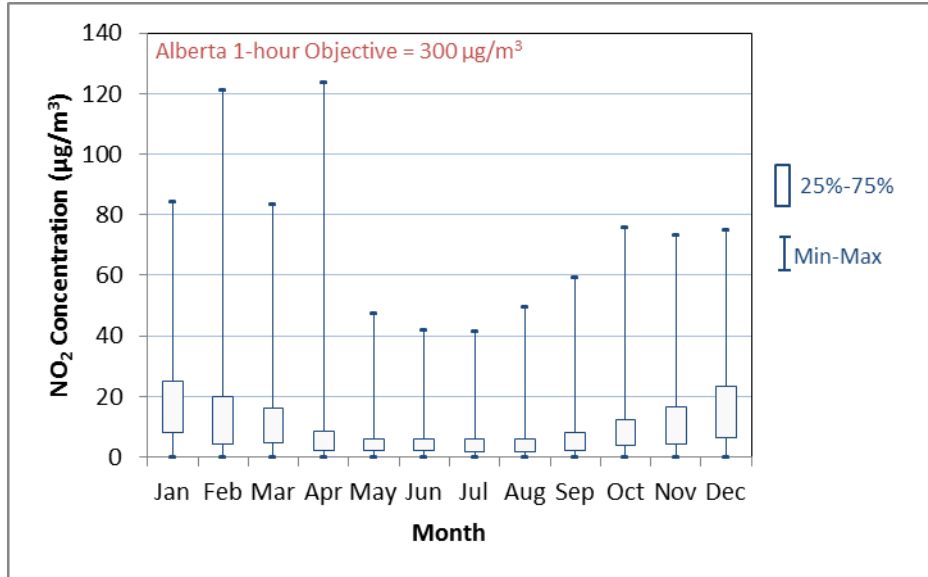


Figure E 59: Seasonal Variation of 1-hour NO₂ Concentrations ($\mu\text{g}/\text{m}^3$) at Tomahawk

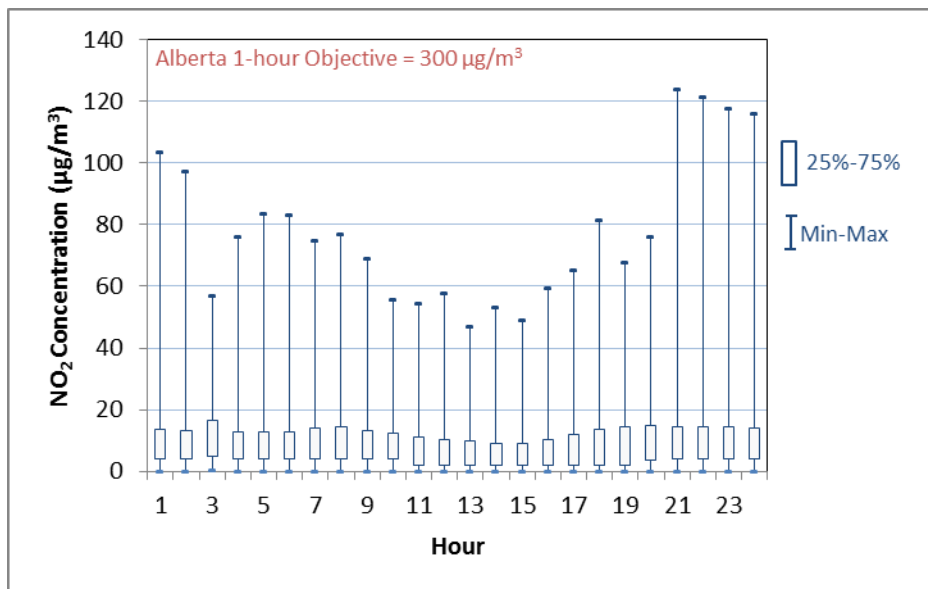


Figure E 60: Diurnal Variation of 1-Hour NO₂ Concentrations ($\mu\text{g}/\text{m}^3$) at Tomahawk



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SO₂

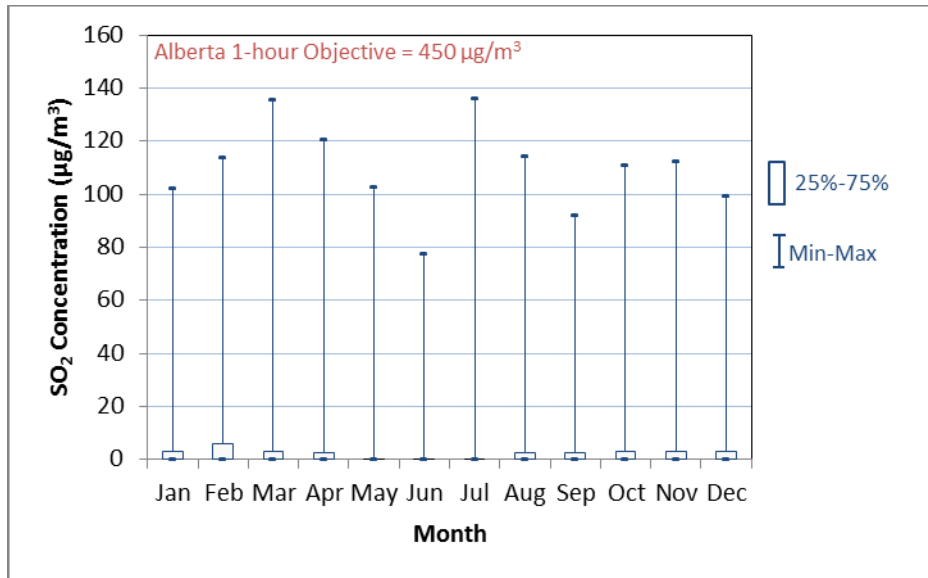
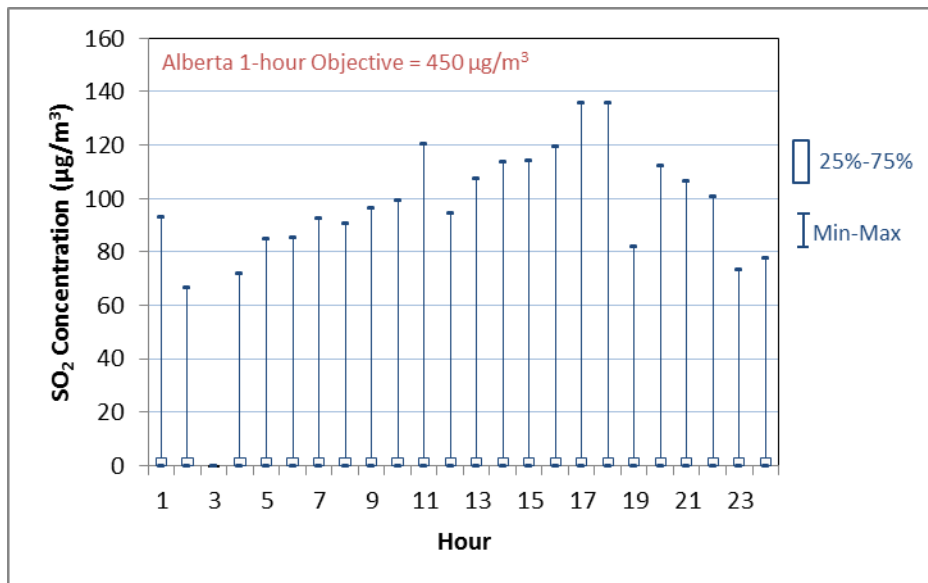


Figure E 61: Seasonal Variation of 1-hour SO₂ Concentrations (µg/m³) at Meadows



Note: Daily instrumental zero/span occurred at 03:00 for the majority of the sampling period and therefore there are limited measurement data at 03:00.

Figure E 62: Diurnal Variation of 1-Hour SO₂ Concentrations (µg/m³) at Meadows



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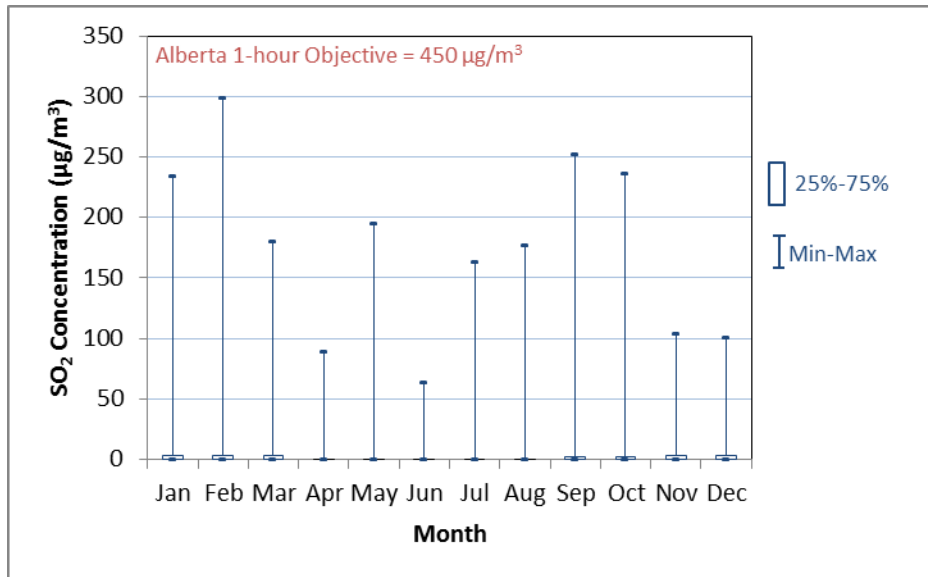


Figure E 63: Seasonal Variation of 1-hour SO_2 Concentrations ($\mu\text{g}/\text{m}^3$) at Power

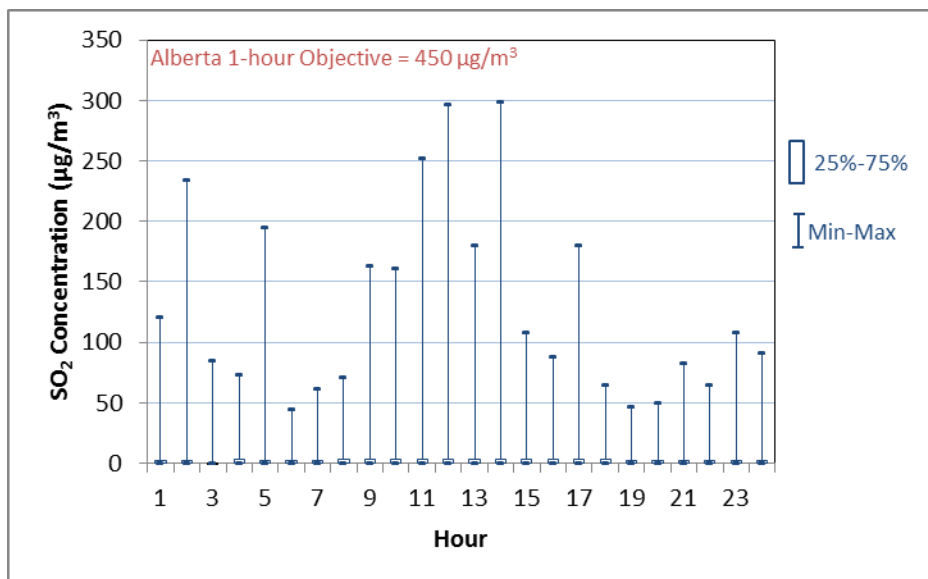


Figure E 64: Diurnal Variation of 1-Hour SO_2 Concentrations ($\mu\text{g}/\text{m}^3$) at Power

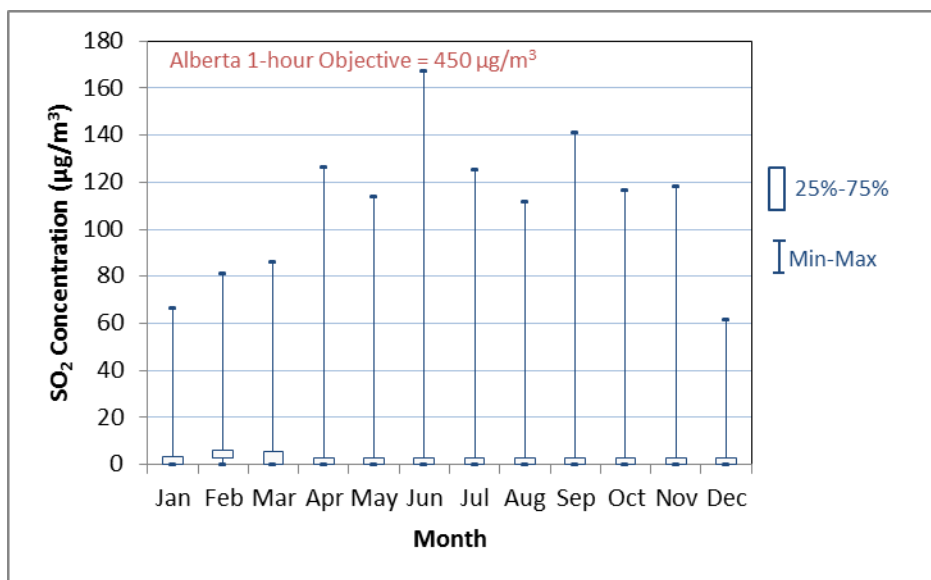
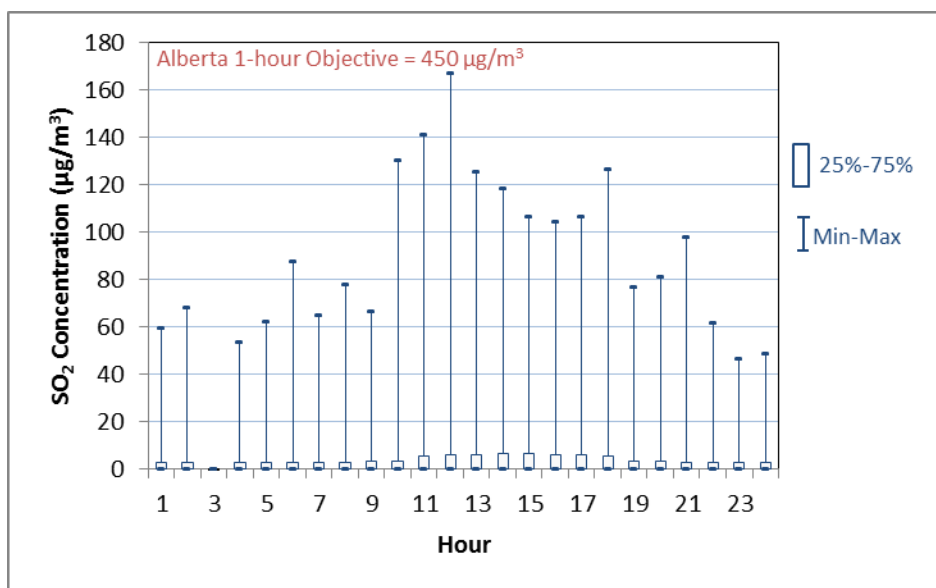


Figure E 65: Seasonal Variation of 1-hour SO₂ Concentrations (µg/m³) at Wagner



Note: Daily instrumental zero/span occurred at 03:00 for the majority of the sampling period and therefore there are limited measurement data at 03:00.

Figure E 66: Diurnal Variation of 1-Hour SO₂ Concentrations (µg/m³) at Wagner



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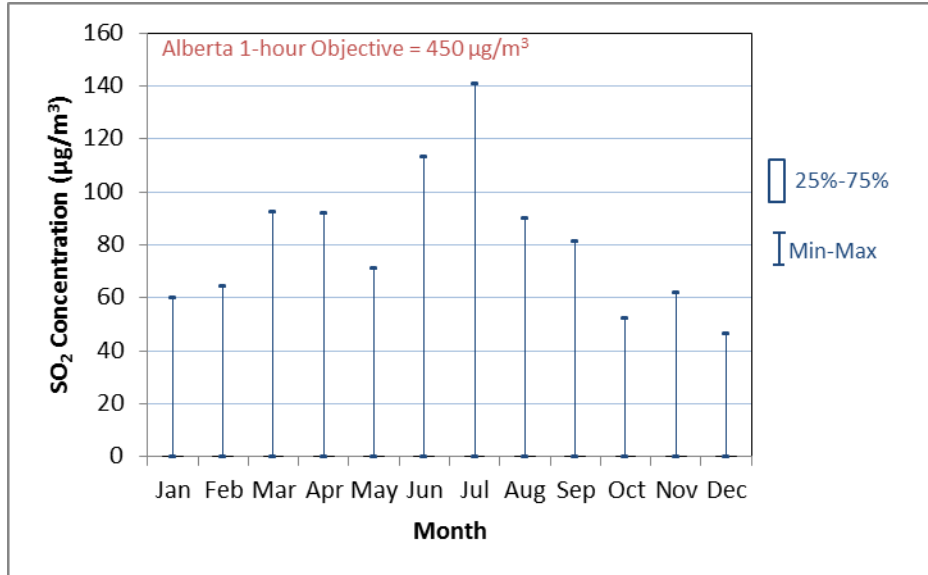
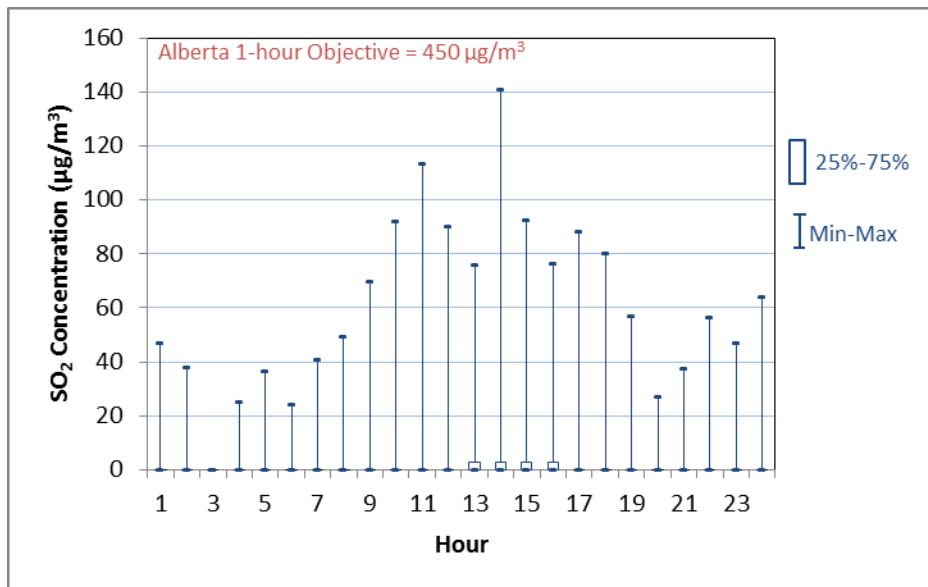


Figure E 67: Seasonal Variation of 1-hour SO₂ Concentrations ($\mu\text{g}/\text{m}^3$) at Wagner 2



Note: Daily instrumental zero/span occurred at 03:00 for the majority of the sampling period and therefore there are limited measurement data at 03:00.

Figure E 68: Diurnal Variation of 1-Hour SO₂ Concentrations ($\mu\text{g}/\text{m}^3$) at Wagner 2



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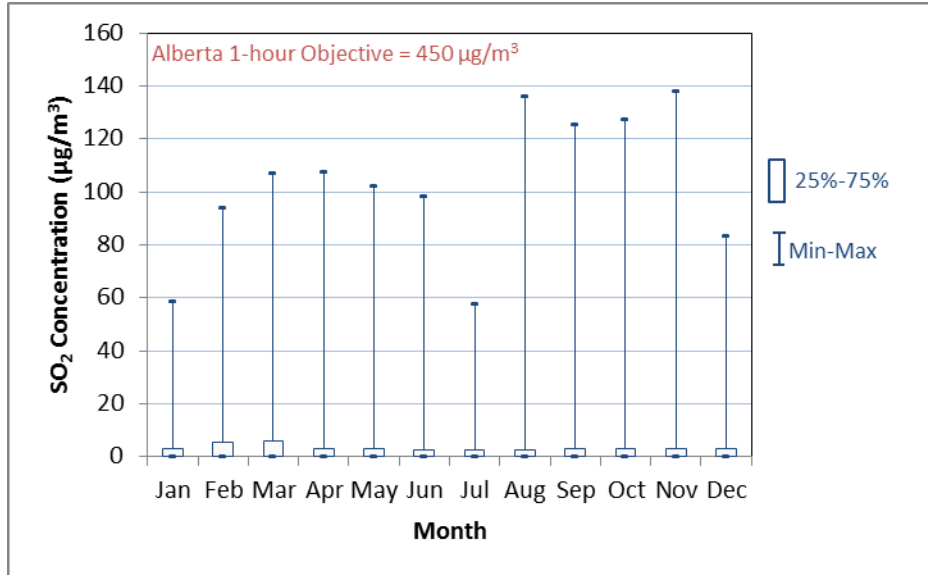


Figure E 69: Seasonal Variation of 1-hour SO₂ Concentrations ($\mu\text{g}/\text{m}^3$) Tomahawk

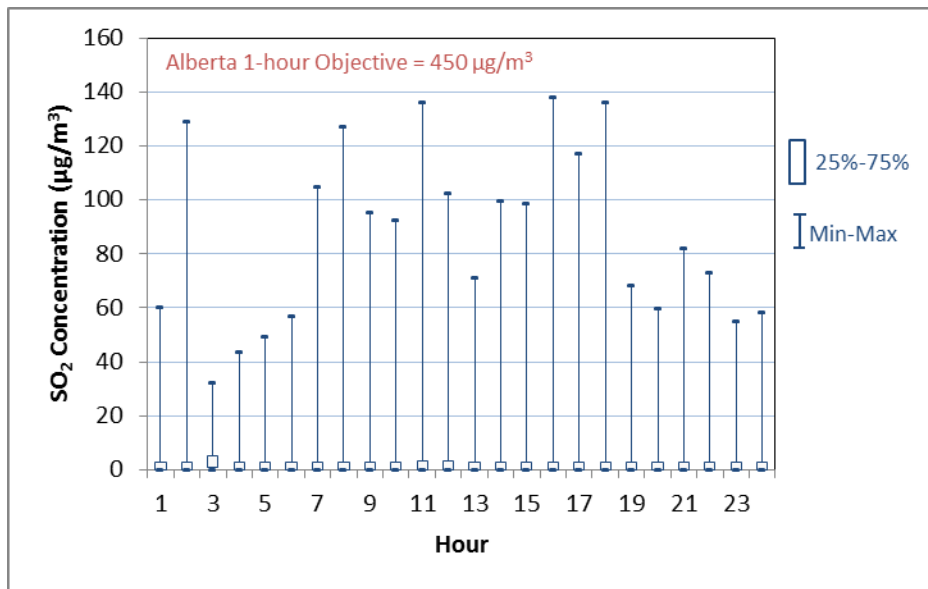


Figure E 70: Diurnal Variation of 1-Hour SO₂ Concentrations ($\mu\text{g}/\text{m}^3$) at Tomahawk



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Edson Area

PM_{2.5}

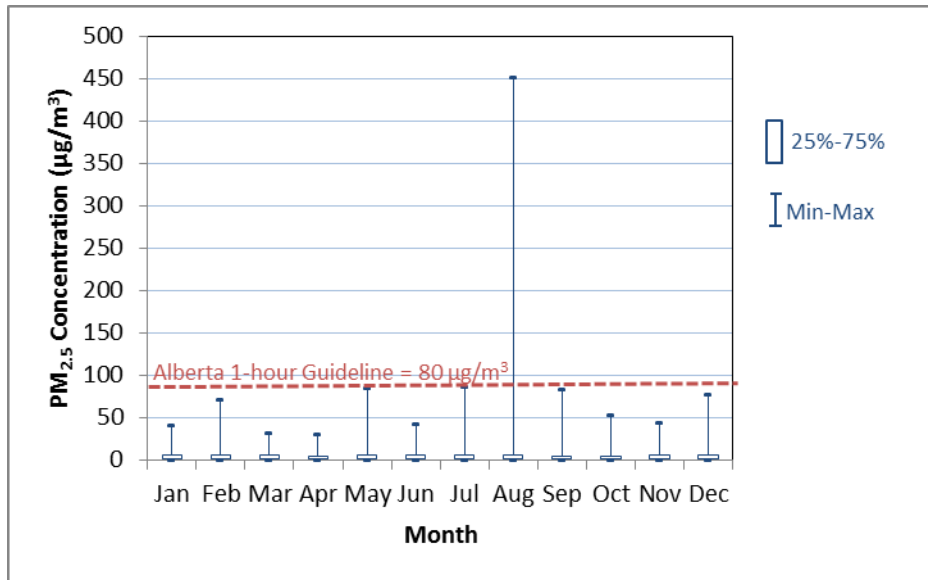


Figure E 71: Seasonal Variation of 1-hour PM_{2.5} Concentrations (µg/m³) at Edson

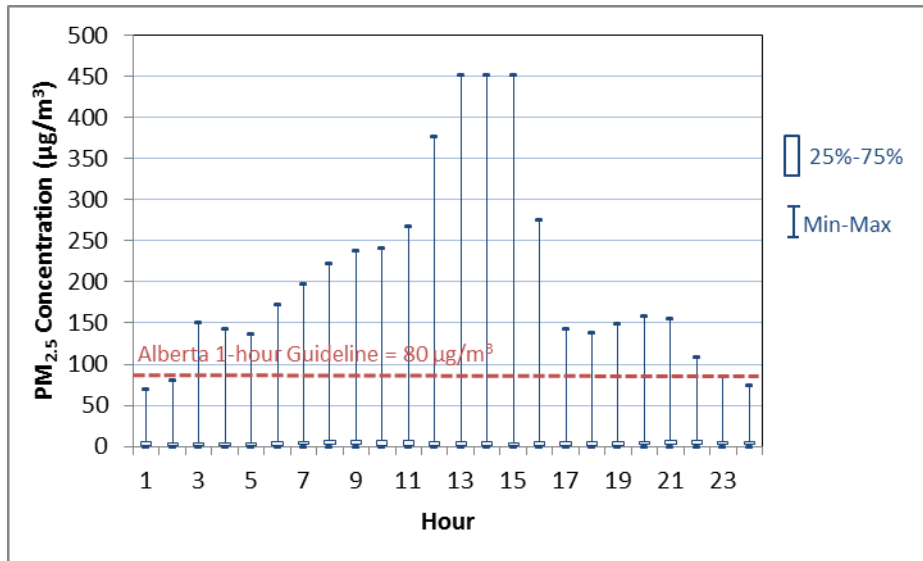


Figure E 72: Diurnal Variation of 1-Hour PM_{2.5} Concentrations (µg/m³) at Edson



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NO₂

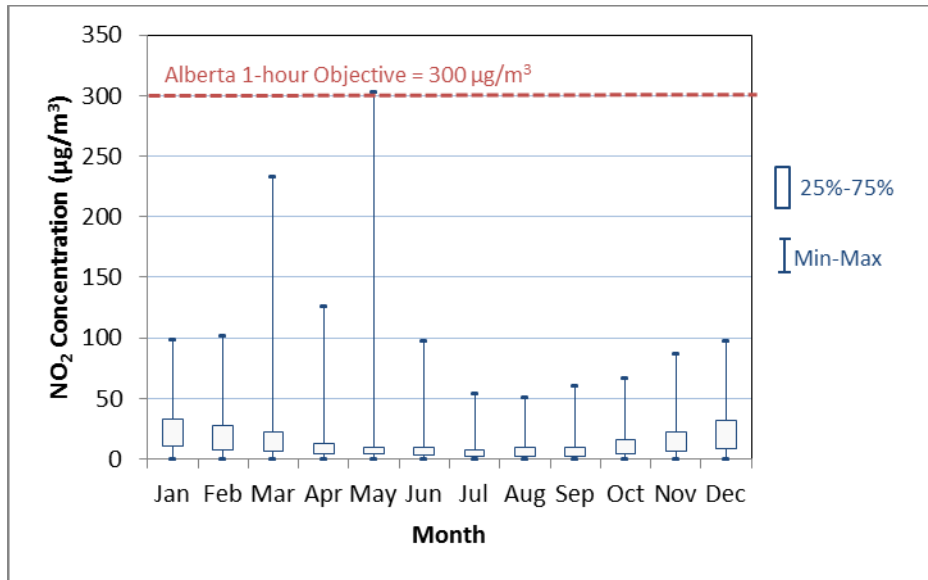


Figure E 73: Seasonal Variation of 1-hour NO₂ Concentrations (µg/m³) at Carrot Creek

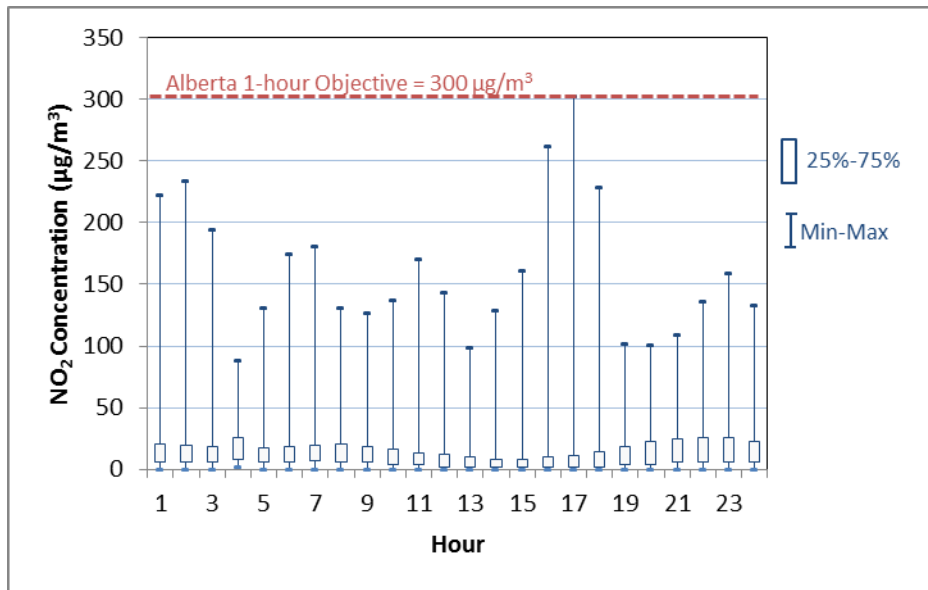


Figure E 74: Diurnal Variation of 1-Hour NO₂ Concentrations (µg/m³) at Carrot Creek



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SO₂

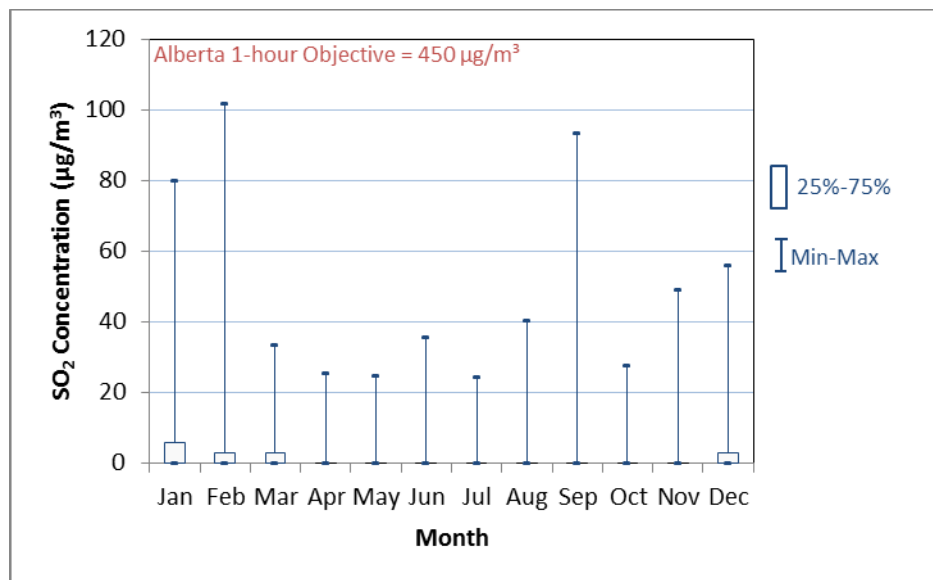


Figure E 75: Seasonal Variation of 1-hour SO₂ Concentrations (µg/m³) at Edson

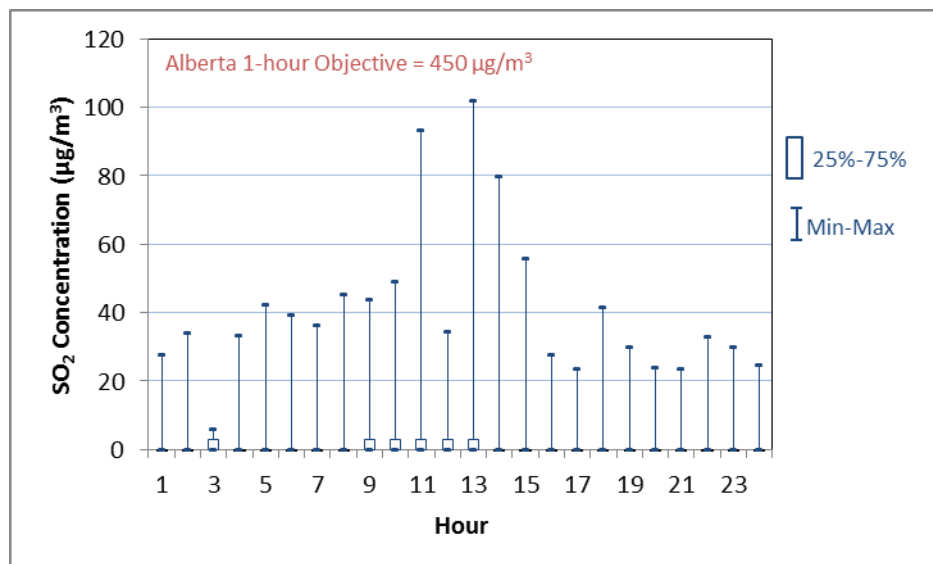


Figure E 76: Diurnal Variation of 1-Hour SO₂ Concentrations (µg/m³) at Edson



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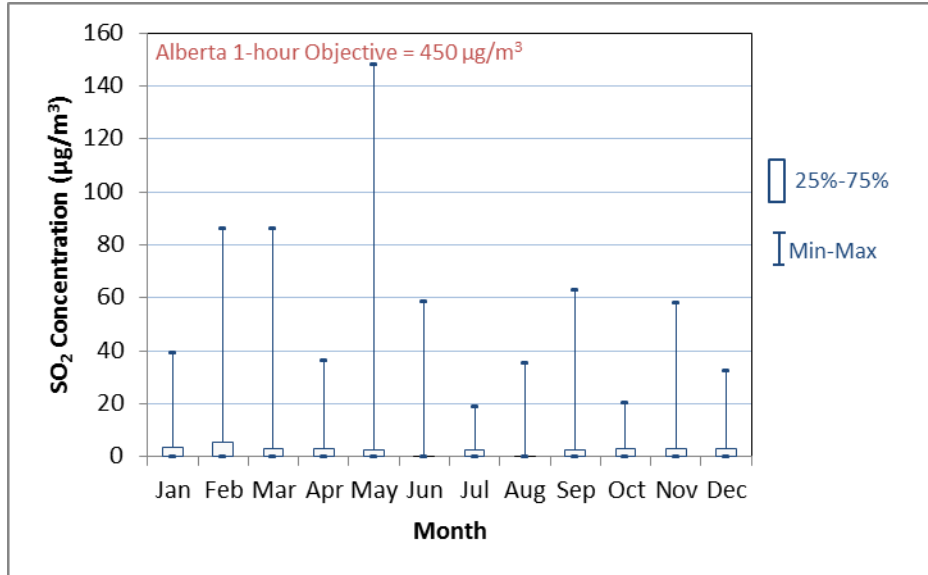


Figure E 77: Seasonal Variation of 1-hour SO₂ Concentrations (µg/m³) at Carrot Creek

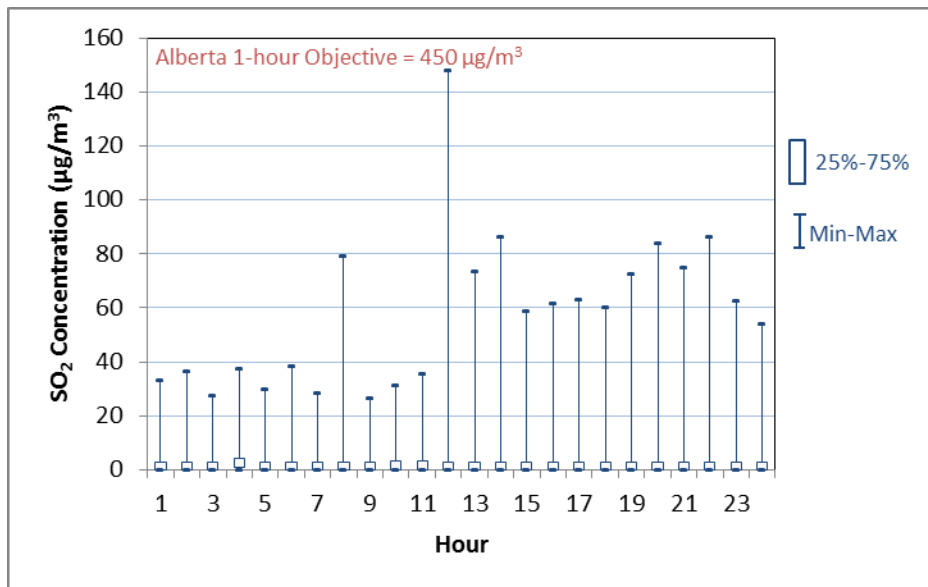


Figure E 78: Diurnal Variation of 1-Hour SO₂ Concentrations (µg/m³) at Carrot Creek



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Hinton Area

PM₁₀

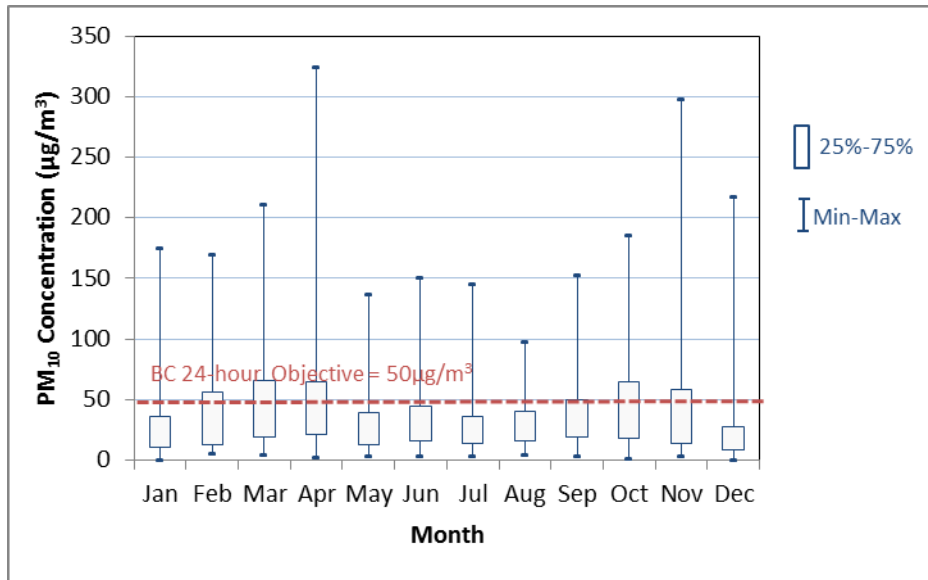


Figure E 79: Seasonal Variation of 24-hour PM₁₀ Concentrations (µg/m³) at Hinton

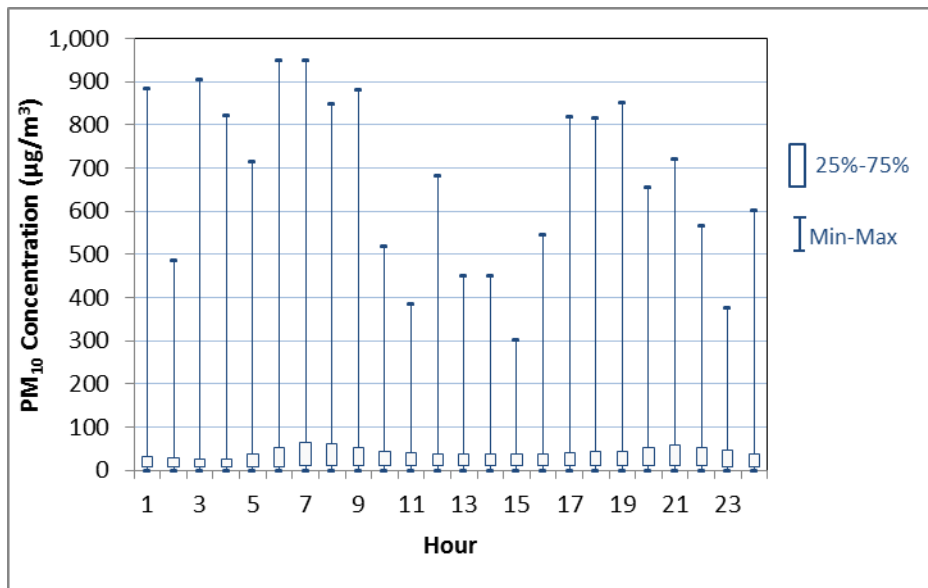


Figure E 80: Diurnal Variation of 1-Hour PM₁₀ Concentrations (µg/m³) at Hinton



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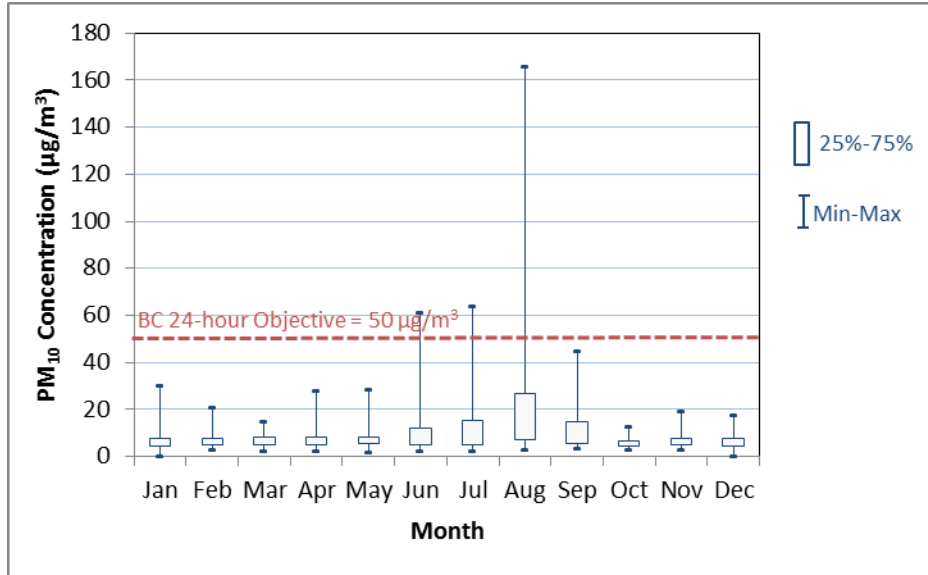


Figure E 81: Seasonal Variation of 24-hour PM₁₀ Concentrations (µg/m³) at Steeper

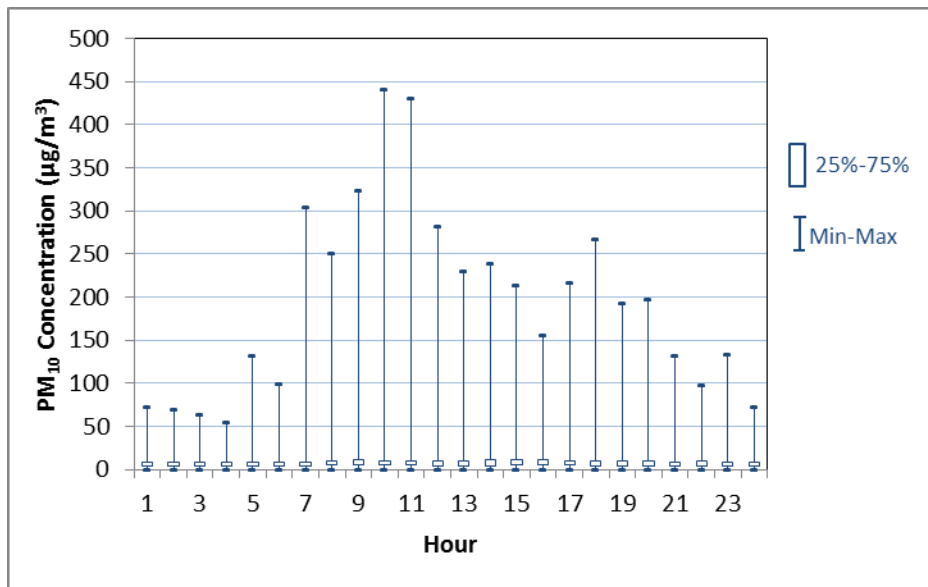


Figure E 82: Diurnal Variation of 1-Hour PM₁₀ Concentrations (µg/m³) at Steeper



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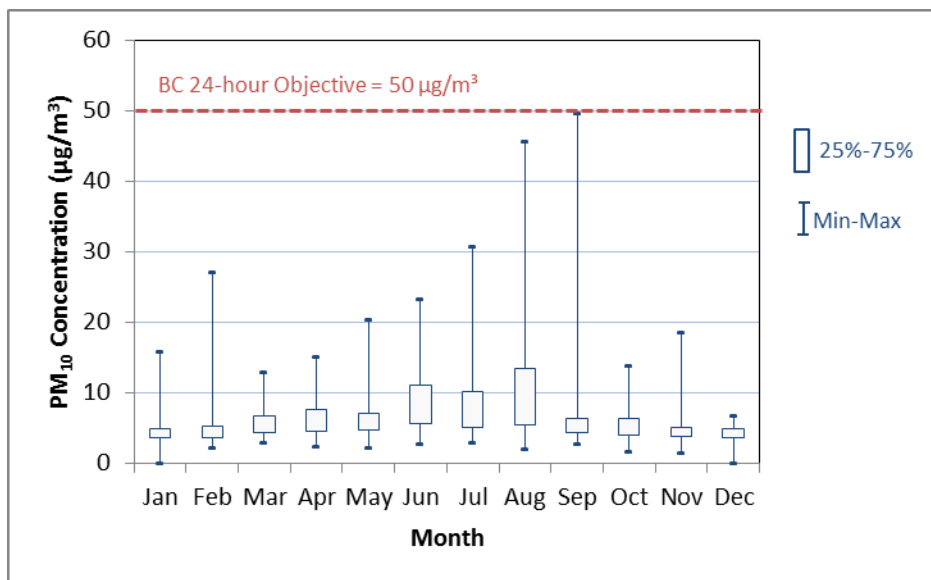


Figure E 83: Seasonal Variation of 24-hour PM₁₀ Concentrations (µg/m³) at Hightower Ridge

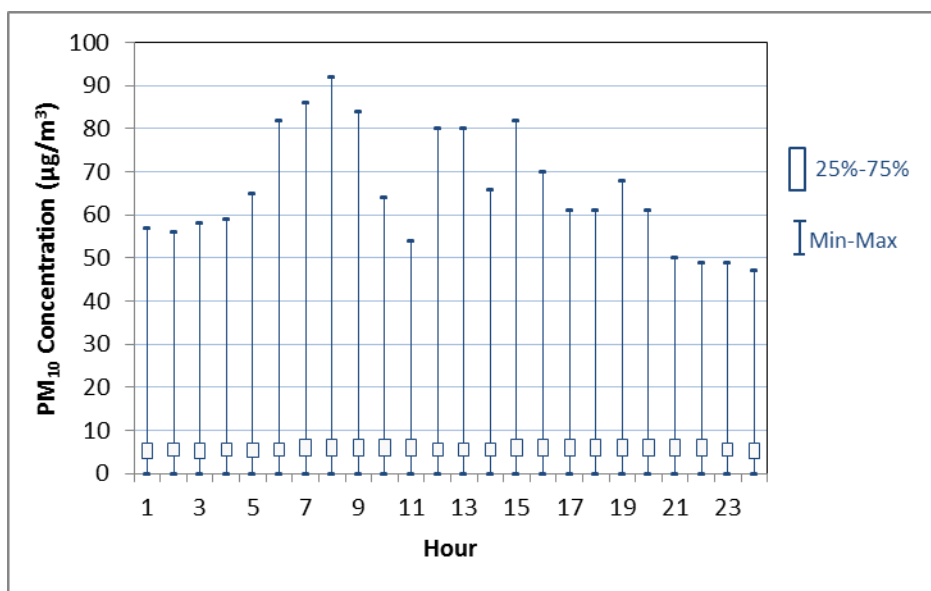


Figure E 84: Diurnal Variation of 1-Hour PM₁₀ Concentrations (µg/m³) at Hightower Ridge



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PM_{2.5}

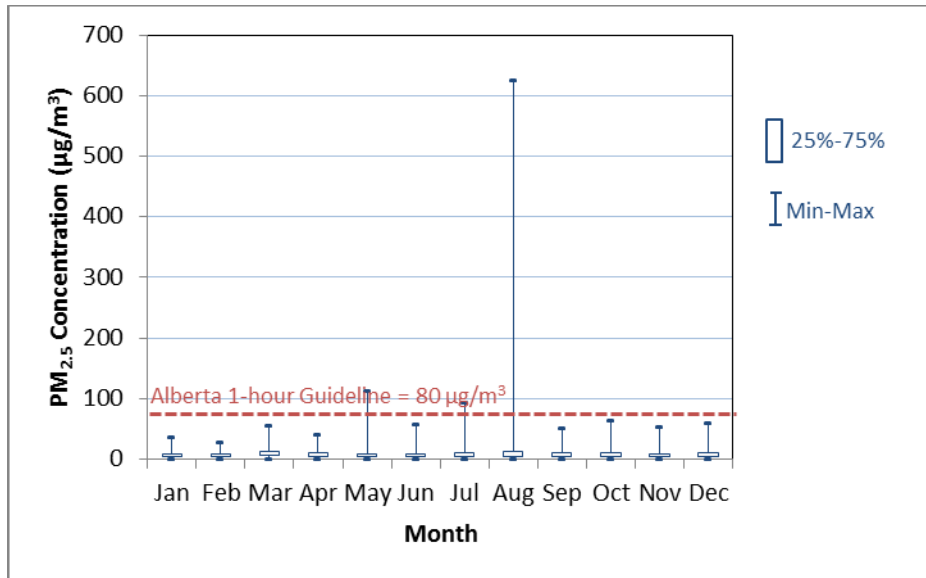


Figure E 85: Seasonal Variation of 1-hour PM_{2.5} Concentrations (µg/m³) at Hinton

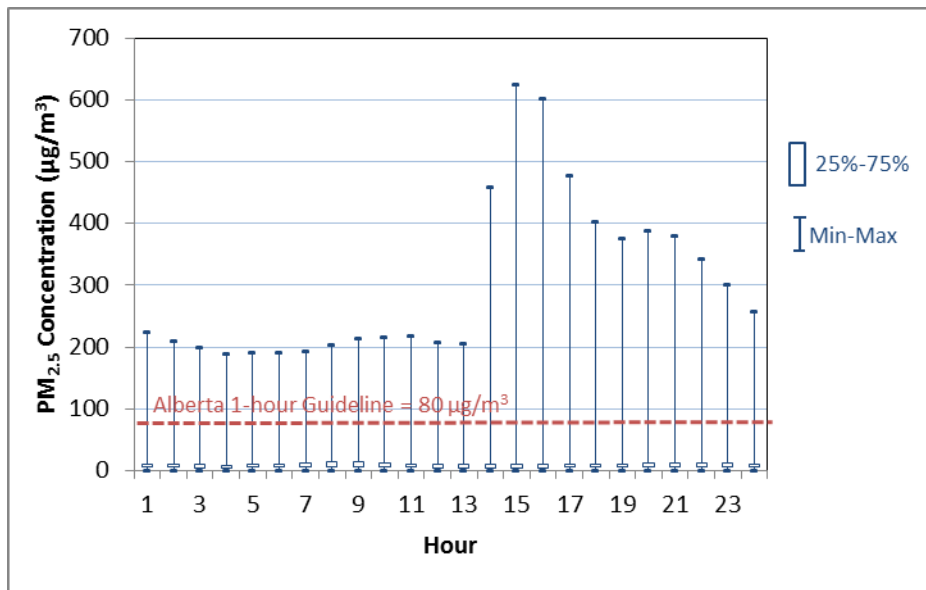


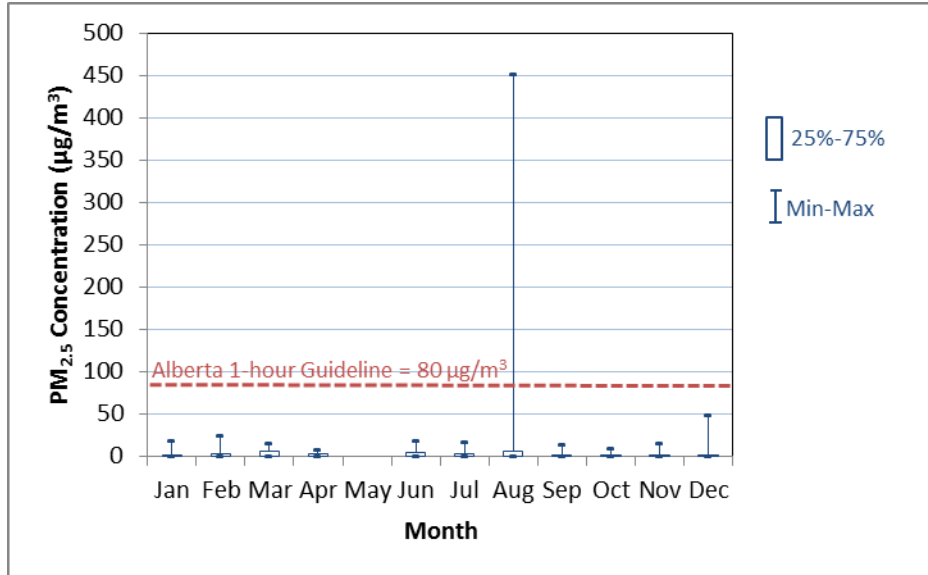
Figure E 86: Diurnal Variation of 1-Hour PM_{2.5} Concentrations (µg/m³) at Hinton



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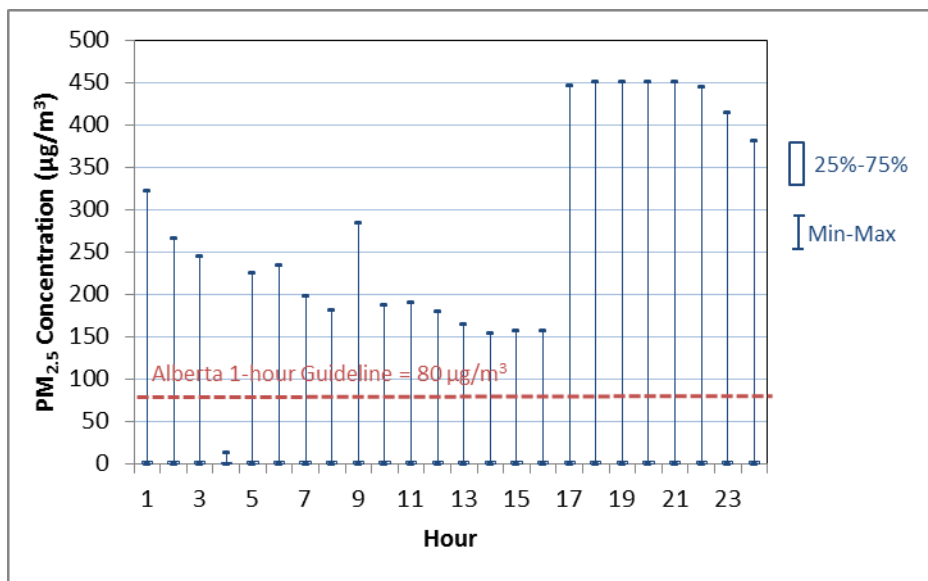
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Note: No measurement data are available for May.

Figure E 87: Seasonal Variation of 1-hour $PM_{2.5}$ Concentrations ($\mu g/m^3$) at Steeper



Note: Daily instrumental zero/span occurred at 04:00 for the majority of the sampling period and therefore there are limited measurement data at 04:00.

Figure E 88: Diurnal Variation of 1-Hour $PM_{2.5}$ Concentrations ($\mu g/m^3$) at Steeper



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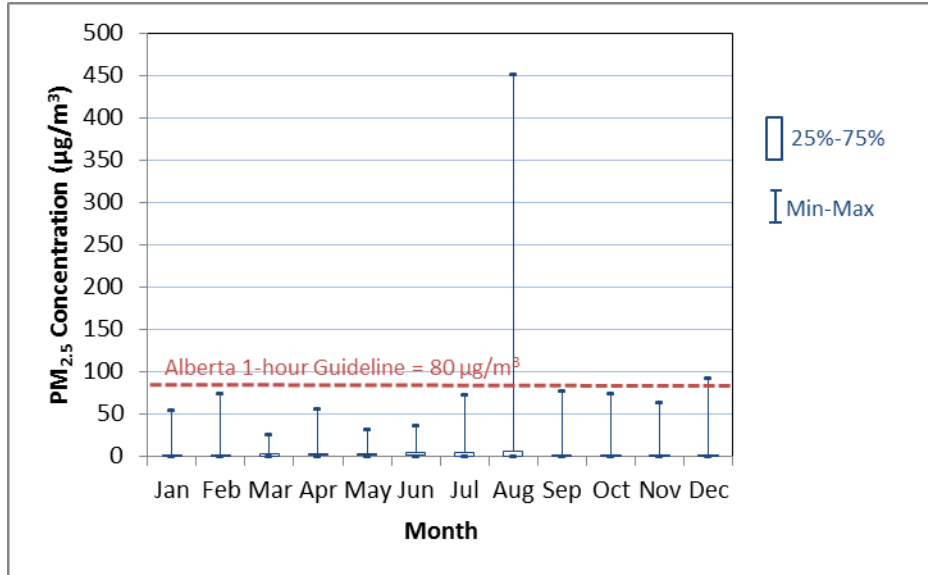


Figure E 89: Seasonal Variation of 1-hour $PM_{2.5}$ Concentrations ($\mu g/m^3$) at Hightower Ridge

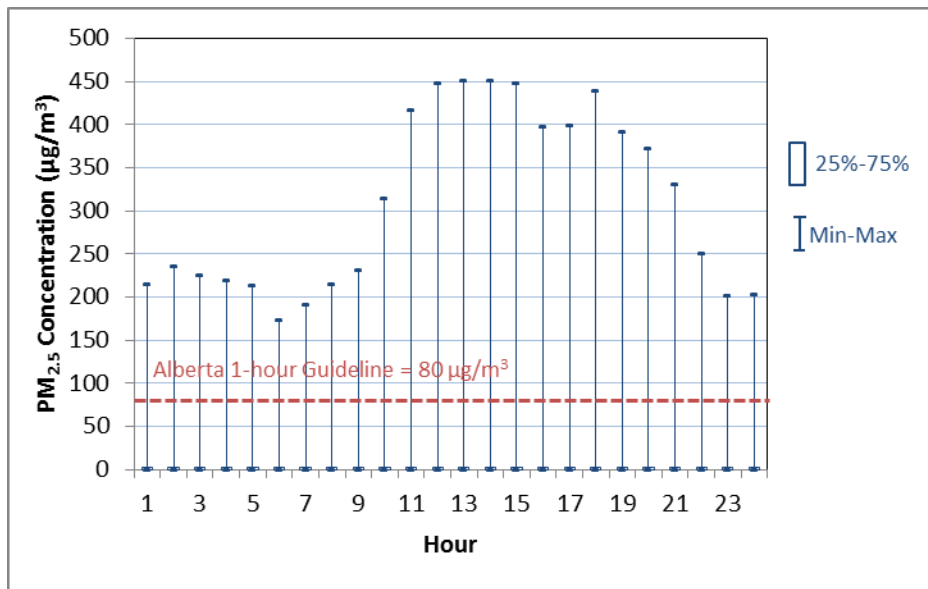


Figure E 90: Diurnal Variation of 1-Hour $PM_{2.5}$ Concentrations ($\mu g/m^3$) at Hightower Ridge



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NO₂

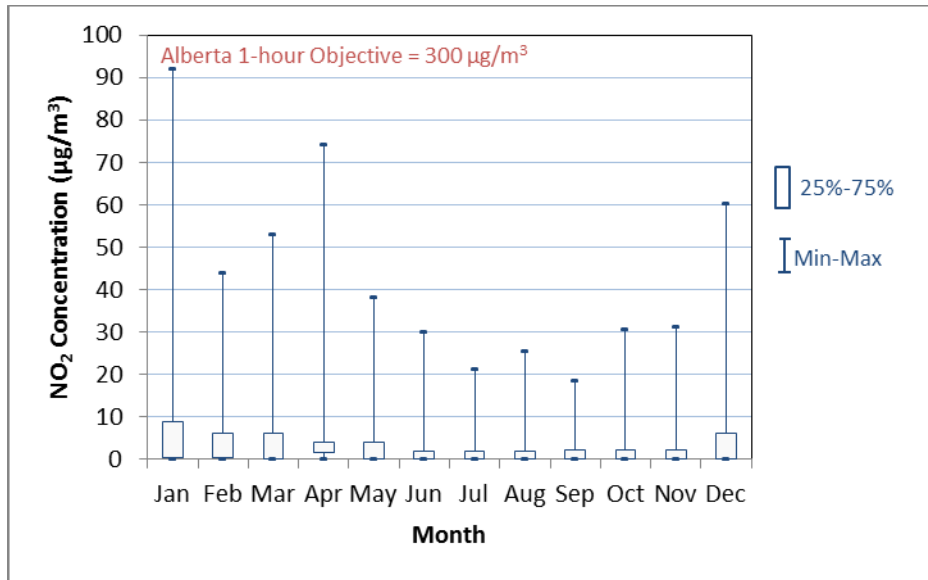


Figure E 91: Seasonal Variation of 1-hour NO₂ Concentrations (µg/m³) at Steeper

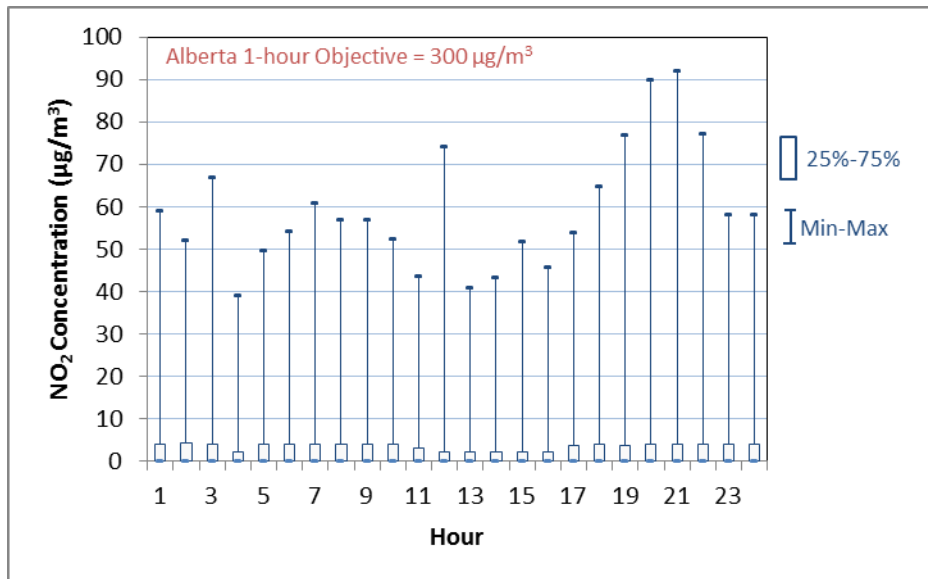


Figure E 92: Diurnal Variation of 1-Hour NO₂ Concentrations (µg/m³) at Steeper