APPENDIX C – PART 3

APPENDIX 6

CALPUFF Description

Pacific NorthWest LNG

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1 INTRODUCTION

This appendix provides technical details and assumptions regarding the CALPUFF modelling system used to investigate the air quality effects of the proposed Pacific NorthWest LNG Ltd. (PNW LNG) Partnership (the Project). What follows is an overview of the initialization and parameterization of CALPUFF, a technical description of the model, and Project specific information that is applied in CALPUFF.

2 CALPUFF MODELLING

2.1 Model Description

The CALPUFF modelling system consists of a meteorological model CALMET (6.326 level 080709), and a transport and dispersion model CALPUFF (version 6.262 level 080725) and several pre and post processors.

The CALMET meteorological model provides the meteorological data necessary to initialize the CALPUFF dispersion model. Terrain and land use data describe the region of interest and meteorological input from numerous sources are used to initialize the model. Various user-defined parameters control the input meteorological data interpolation to the grid, as well as the application of the internal algorithms to the input fields. The following sections provide more details regarding these options. Output from the CALMET model includes hourly temperature and wind fields on a user-specified three-dimensional domain as well as additional two-dimensional variables used by the CALPUFF dispersion model. Appendix 5 of the Air Quality Technical Data Report (AQ TDR) discusses the CALMET meteorological model in detail.

CALPUFF is a non-steady-state Gaussian puff dispersion model capable of simulating the effects of time and space-varying meteorological conditions on contaminant transport, transformation, and removal (Scire et al. 2000a). This model requires time-variant two- and three-dimensional meteorological data output from CALMET, as well as information regarding the relative location and nature of the emission sources modelled. The following sections provide a discussion of the available and implemented model options. Output from the CALPUFF model includes ground-level concentrations of the air contaminant species considered, as well as dry and wet deposition fluxes.

Table 6-1 summarizes the major features and options of the CALPUFF model. Some of the technical algorithms are described below. Table 6-3 shows the modelling options enabled for the Project dispersion simulations.

Table 6-1: Summary of Major Features of CALPUFF

- **Source types**
  - Point sources (constant or variable emissions)
  - Line sources (constant or variable emissions)
  - Volume sources (constant or variable emissions)
  - Area sources (constant or variable emissions)
- **Non-steady-state emissions and meteorological conditions**
  - Gridded 3-D fields of meteorological variables (winds, temperature)
  - Spatially-variable fields of mixing height, friction velocity, convective velocity scale, Monin-Obukhov length, precipitation rate
  - Vertically and horizontally-varying turbulence and dispersion rates
  - Time-dependent source and emissions data
- **Efficient sampling functions**
  - Integrated puff formulation
  - Elongated puff (slug) formulation
- **Dispersion coefficient (σ_y, σ_z) options**
  - Direct measurements of σ_v and σ_w
  - Estimated values of σ_v and σ_w based on similarity theory
  - Pasquill-Gifford (PG) dispersion coefficients (rural areas)
  - McElroy-Pooler (MP) dispersion coefficients (urban areas)
  - CTDM dispersion coefficients (neutral/stable)
- **Vertical wind shear**
  - Puff splitting
  - Differential advection and dispersion
- **Plume rise**
  - Partial penetration
  - Buoyant and momentum rise
  - Stack tip effects
  - Vertical wind shear
  - Building downwash effects
- **Building downwash**
  - Huber-Snyder method
  - Schulman-Scire method

(Continued)

Table 6-1: Summary of Major Features of CALPUFF (*Continued)*

- **Subgrid scale complex terrain**
  - Dividing streamline, H_d:
    - Above H_d, puff flows over the hill and experiences altered diffusion rates
    - Below H_d, puff deflects around the hill, splits, and wraps around the hill
- **Interface to the Emissions Production Model (EPM)**
  - Time-varying heat flux and emissions from controlled burns and wildfires
- **Dry Deposition**
  - Gases and particulate matter
  - Three options:
    - Full treatment of space and time variations of deposition with a resistance model
    - User-specified diurnal cycles for each pollutant
    - No dry deposition
- **Overwater and coastal interaction effects**
  - Overwater boundary layer parameters
  - Abrupt change in meteorological conditions, plume dispersion at coastal boundary
  - Plume fumigation
  - Option to introduce subgrid scale Thermal Internal Boundary Layers (TIBLs) into coastal grid cells
- **Chemical transformation options**
  - Pseudo-first-order chemical mechanism for SO_2, $SO_4^=$, NO_x, HNO_3, and NO_3^- (MESOPUFF II method)
  - User-specified diurnal cycles of transformation rates
  - No chemical conversion
- **Wet Removal**
  - Scavenging coefficient approach
  - Removal rate a function of precipitation intensity and precipitation type
- **Graphical User Interface**
  - Point-and-click model setup and data input
  - Enhanced error checking of model inputs
  - On-line Help files

Chemical Transformation: CALPUFF includes options for parameterizing chemical transformation effects using the five species scheme (SO_2, SO, NO_X, HNO_3, and NO) employed in the MESOPUFF II model, the six species RIVAD/ARM3 scheme, or a set of user-specified, diurnally-varying transformation rates. The RIVAD/ARM3 reactions separately model NO and NO_2 rather than NO_X. Calculations of chemical transformations require, among other information, knowledge of background concentrations of ozone and ammonia.

Subgrid Scale Complex Terrain: The complex terrain module in CALPUFF is based on the approach used in the Complex Terrain Dispersion Model (CTDMPLUS) (Perry et al., 1989). Plume impingement on subgrid scale hills is evaluated using a dividing streamline (Hd) to determine which contaminant material is deflected around the sides of a hill (below Hd) and which material is advected over the hill (above Hd). Individual puffs are split in up to three sections for these calculations.

Puff Sampling Functions: A set of accurate and computationally efficient puff sampling routines are included in CALPUFF, which solve many of the computational difficulties with applying a puff model to near-field releases. For near-field applications during rapidly varying meteorological conditions, an elongated puff (slug) sampling function can be used. An integrated puff approach is used during less demanding conditions. Both techniques reproduce continuous plume results exactly under the appropriate steady state conditions.

Wind Shear Effects: CALPUFF contains an optional puff-splitting algorithm that allows vertical wind shear effects across individual puffs simulated. Differential rates of dispersion and transport occur on the puffs generated from the original puff, which under some conditions can substantially increase the effective rate of horizontal growth of the plume.

Building Downwash: Both the Huber-Snyder and Schulman-Scire downwash models are incorporated into CALPUFF. An option is provided to use either model for all stacks, or make the choice on a stack-by-stack and wind sector-by-wind sector basis. Both algorithms are implemented in such a way as to allow the use of wind direction specific building dimensions.

Overwater and Coastal Interaction Effects: Because the CALMET meteorological model contains overwater and overland boundary layer algorithms, the effects of water bodies on plume transport, dispersion, and deposition can be simulated with CALPUFF. The puff formulation of CALPUFF is designed to handle spatial changes in meteorological and dispersion conditions, including the abrupt changes that occur at the coastline of a major body of water.

Dispersion Coefficients: Several options are provided in CALPUFF for the computation of dispersion coefficients. These include the use of turbulence measurements (σ_v and σ_w), the use of similarity theory to estimate σ_v and σ_w from modelled surface heat and momentum fluxes, the use of Pasquill-Gifford (PG) or McElroy-Pooler (MP) dispersion coefficients, or dispersion equations based on the Complex Terrain Dispersion Model (CTDM). Options for an averaging time correction or surface roughness length adjustment to the PG coefficients are available.

Dry Deposition: A full resistance model is provided in CALPUFF for the computation of dry deposition rates of gases and particulate matter as a function of geophysical parameters, meteorological conditions, and contaminant species. Options are provided to allow user-specified, diurnally varying deposition velocities to be used for one or more contaminants instead of the resistance model (e.g., for sensitivity testing) or to by-pass the dry deposition model completely.

Wet Deposition: An empirical scavenging coefficient approach is used in CALPUFF to compute the depletion and wet deposition fluxes due to precipitation scavenging. The scavenging coefficients are specified as a function of the contaminant and precipitation type (i.e., frozen vs. liquid precipitation).

2.2 Model Initialization

2.2.1 Meteorological Data

Meteorological data such as mixing heights, stability and winds determine the transport and dispersion of contaminants within the CALPUFF model. To capture puff behavior under a variety of meteorological conditions, three years of modelling was considered for this project. Hourly three-dimensional meteorological fields for the 2008, 2009, and 2010 were prepared using the CALMET model, as described in Appendix 5 of the AQ TDR.

2.2.2 Computational Domain

CALPUFF is used to conduct dispersion modelling over a computational domain that is a subset of the CALMET meteorological grid (defined in Appendix 5 of the AQ TDR). Table 6-2 contains the computational grid extents relative to the meteorological grid. The computational grid is the full extents of the meteorological grid.

Table 6-2: Location of Computational Grid Relative to the Meteorological Grid

Location of computation grid	X Index	Y Index
Lower Left corner	1	1
Upper right corner	104	104

2.2.3 Emissions and Source Characteristic

CALPUFF was used to model the dispersion of emissions from the source combinations specified for three phases of the Project. Appendix 4 of the AQ TDR discusses rates of emission for each species of concern as well as source characteristics used in the modelling.

2.2.4 Receptor Grid

Multiple nested receptor grids centered on the midpoint between Lelu Island (the Project site) and the marine berth were established for the purposes of dispersion modelling. The grid spacing of the receptors follows the spacing recommended by BC Ministry of Environment (BC MOE) Guidelines for Air Dispersion Modelling in British Columbia (2008) (see Figure 6-1).

- 20 m spacing along fence line
- 20 m spacing over maximum point of impingement
- 50 m spacing within 500 m of sources
- 250 m spacing within 2 km of sources
- 500 m spacing within 5 km of sources
- 1,000 m spacing beyond 5 km of sources
- Discrete receptors.

Terrain and receptor elevations in the model were initialized with data from the Natural Resources Canada Canadian Digital Elevation Data (CDED). The CDED (Geobase 2011) consist of an ordered array of ground level elevations at regularly spaced intervals. Depending on the latitude of the CDED section, the grid spacing varies in resolution from a minimum of 0.75 arc seconds to a maximum 3.0 arc seconds (about 90 m). An in-house terrain preprocessor was used to determine the receptor elevation by a distance-weighted two-dimensional interpolation of the elevation values at the four nearest elevation data nodes surrounding the receptor location.

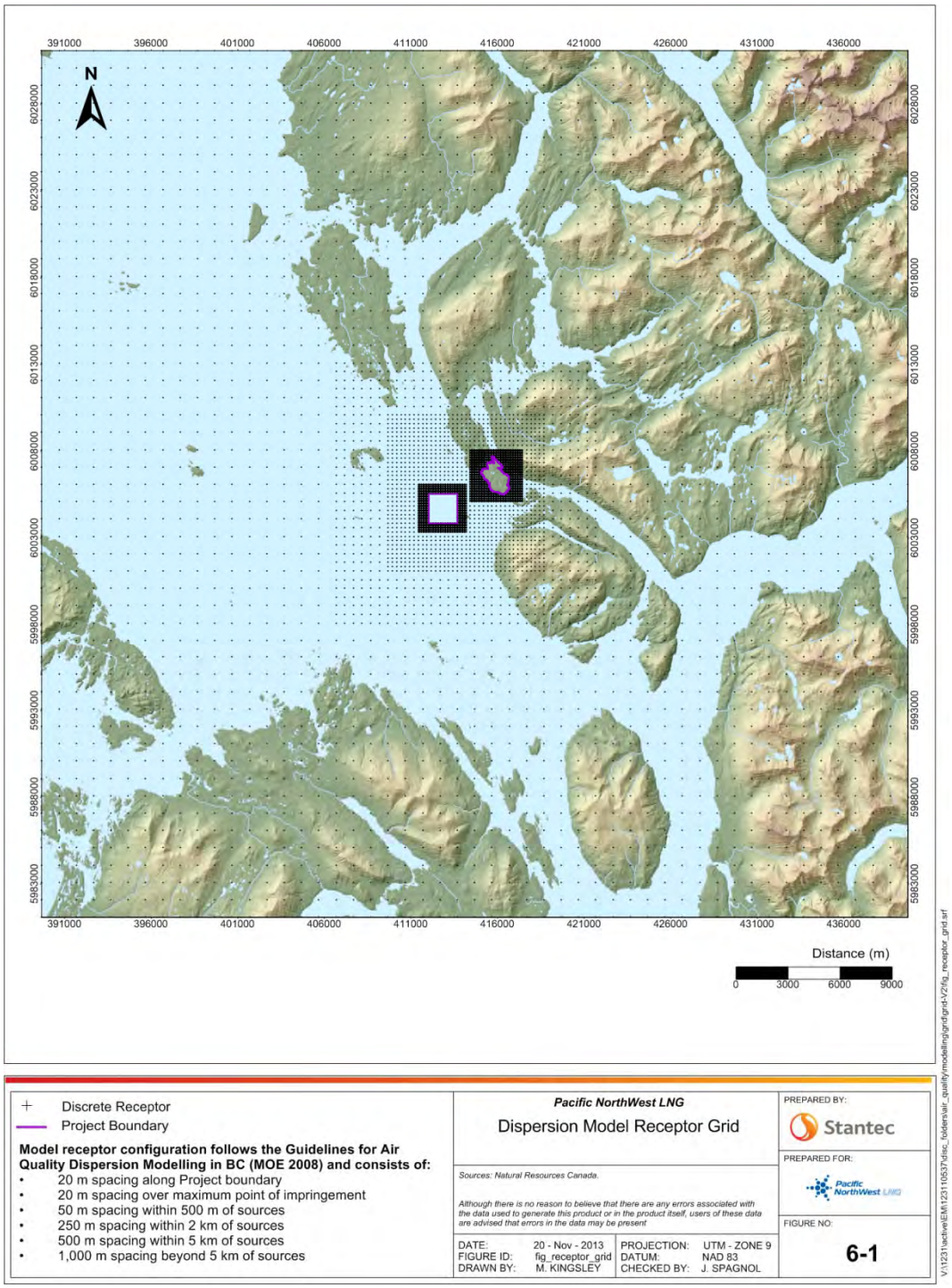

Figure 6-1: Model Receptor Grid

2.2.5 Terrain Effects

The CALPUFF model was used to estimate concentrations, for each species considered, at each receptor location. Since some of these receptors were located in terrain elevations greater than puff release points, terrain effects were considered. To account for the possible distortion of the plume trajectory over elevated terrain, the Partial Plume Path Adjustment Method (PPPAM) was used to modify the height of the plume.

The PPPAM employs a plume path coefficient (PPC) to adjust the height of the plume above the ground. As recommended by the CALPUFF authors, the default PPC values used are 0.5, 0.5, 0.5, 0.5, 0.35, and 0.35 for the corresponding Pasquill-Gifford stability classes A, B, C, D, E, and F (Pasquill, 1961).

2.2.6 Dispersion Coefficients

A fundamental parameter controlling plume dispersion in a Gaussian model such as CALPUFF are the dispersion coefficients. These values, which must be specified for both the horizontal as well as the vertical directions in the model, can be estimated using several different methods in CALPUFF. For this application, dispersion coefficients were internally computed from turbulence estimates based on micrometeorological data from CALMET (MDISP=2). This method was chosen over the more simplistic default method (MDISP=3) to allow for a better characterization of dispersion in the model.

2.2.7 Building Downwash

Building downwash effects were considered for the main buildings inside the facility boundary. The US EPA Building Profile Input Program (BPIP) was used to create building downwash input for CALPUFF. In CALPUFF there are two options for calculating downwash effects, ISC and PRIME. The PRIME method is preferred but in some cases it causes CALPUFF to crash. In the event of a CALPUFF crash the model was re-run in ISC mode. An analysis of the differences between the two modes was conducted. Figure 4-2 shows the maximum predicted 1-hour NO_2 model results of the ISC and PRIME downwash methods. This figure shows that the differences between the PRIME and ISC model results are minimal.

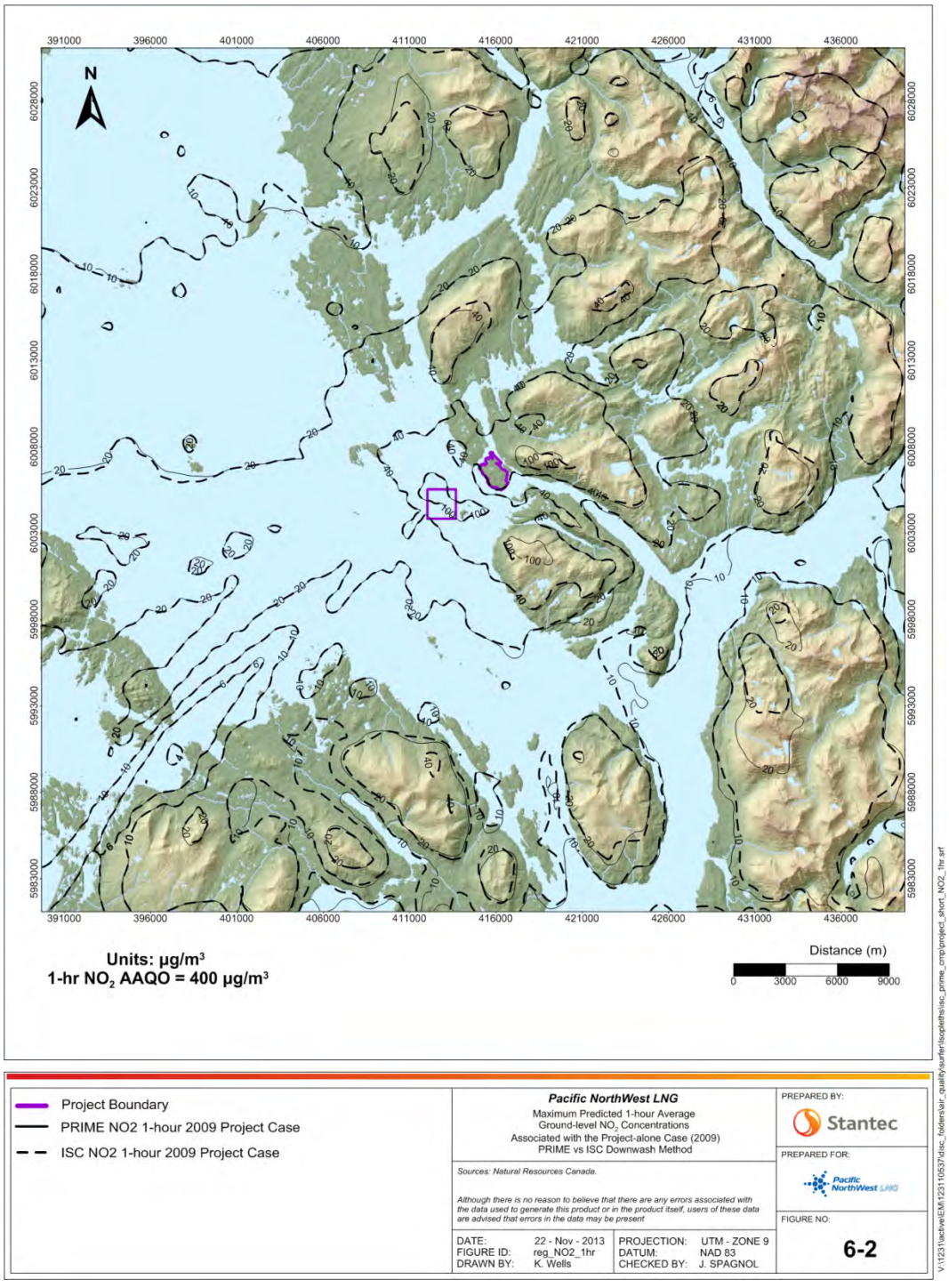

Figure 6-2: Maximum Predicted 1-hour Average Ground-level NO_2 Concentrations Associated with the Project-alone Case (2009) PRIME vs ISC

2.3 Model Options

Table 6-3 provides a summary of all CALPUFF model user options selected for one of the CALPUFF simulations done for this assessment. Model default values as recommended by the United States Environmental Protection Agency (US EPA 1998a) are presented for comparative purposes. In most cases, these default values were used. Model options for CALPUFF Input Group 2 are in accordance with the recommended values specified by the BC MOE Guidelines.

The parameterization shown in Table 6-3 represents a specific source-species-receptor combination. Therefore, application-specific model parameters such as the number of sources and species modelled had different values for different model runs. The configuration specified in Table 6-3 was for one of the Project-alone case simulations.

Table 6-3: CALPUFF Dispersion Model User Options

Input Group	Parameter	USEPA Default	Selected for Project	Description
Group 1: General Run Control Parameters	METRUN	0	0	Run all period in met file
	IBYR	-	2008	Used only if METRUN=0
	IBMO	-	1	Used only if METRUN=0
	IBDY	-	1	Used only if METRUN=0
	IBHR	-	0	Used only if METRUN=0
	XBTZ	-	8	Time Zone, Pacific Standard Time
	NSECDT	3600	3600	Length of modelling time-step
	NSPEC	5	13	Number of chemical species modelled
	NSE	3	10	Number of chemical species emitted
	ITEST	2	2	Continue with model execution after setup
	MRESTART	0	0	Do not write a restart file
	NRESPD	0	0	File written only at last period
	METFM	1	1	CALMET binary type of meteorological file
	AVET	60	60	Averaging time is 60 minutes
	PGTIME	60	60	PG Averaging time is 60 minutes
Group 2: Technical Options	MGAUSS	1	1	Gaussian distribution used in the near field
	MCTADJ	3	3	Partial plume path adjustment method of terrain adjustment
	MCTSG	0	0	Subgrid-scale complex terrain not modelled
	MSLUG	0	0	Near field puffs not elongated
	MTRANS	1	1	Transitional plume rise applied
	MTIP	1	1	Stack tip downwash applied
	MBDW	1	1	ISC Method
	MSHEAR	0	0	Vertical wind shear not modelled
	MSPLIT	0	0	No puff splitting allowed
	MCHEM	1	3	Transformation rates computed internally (RIVAD/ARM3 scheme)
	MAQCHEM	0	0	Aqueous phase transformation not modelled
	MWET	1	1	Wet removal modelled
	MDRY	1	1	Dry removal modelled
	MDISP	3	2	Dispersion coefficients calculated from CALMET micrometeorological variables
	MTURBVW	3	3	Use direct turbulence measurements to estimate dispersion
	MDISP2	3	3	Use PG coefficients when turbulence measurements not available
	MTAULY	0	0	Draxler default 617.284
	MTAUADV	0	0	No turbulence advection

Input Group	Parameter	USEPA Default	Selected for Project	Description
	MCTURB	1	1	CALPUFF subroutines used to compute turbulence
	MROUGH	0	0	Sigma Y and Z are not adjusted for roughness
	MPARTL	1	1	Model partial plume penetration of elevated inversion
	MTINV	0	0	Strength of temperature inversion is computed from default gradients
	MPDF	0	1	Use PDF to compute near-field dispersion under convective conditions
	MSGTIBL	0	0	Sub-grid TIBL module is not used
	MBCON	0	0	Boundary conditions are not modelled
	MSOURCE	0	0	Individual source contributions not saved
	MFOG	0	0	Not configured for fog model output
	MREG	1	0	Do not test options against defaults
Group 3: Species List	CSPEC	-	SO_2, SO_4, NO, NO_2 HNO_3 NO_3, PM1, PM2, PM3, CO, NO_X, H_2S,VOC	List of chemical species
	-		SO_2	Modelled, Emitted, dry deposited (computed gas)
	-		SO_4	Modelled, dry deposited (computed particle)
	-		NO	Modelled, Emitted, dry deposited (computed gas)
	-		NO_2	Modelled, Emitted, dry deposited (computed gas)
	-		HNO_3	Modelled, dry deposited (computed gas)
	-		NO_3	Modelled, dry deposited (computed particle)
			PM1	Modelled, Emitted, dry deposited (computed particle)
			PM2	Modelled, Emitted, dry deposited (computed particle)
			PM3	Modelled, Emitted, dry deposited (computed particle)
			CO	Modelled, Emitted
			NO_X	Modelled, Emitted
			H_2S	Modelled, Emitted
			VOC	Modelled, Emitted

Input Group	Parameter	USEPA Default	Selected for Project	Description
Group 4: Grid Control Parameters	PMAP	UTM	UTM	Universal Transverse Mercator for Projection of all X, Y
	FEAST	0	0	False Easting (Not Used)
	FNORTH	0	0	False Northing (Not Used)
	IUTMZN	-	9	UTM Zone
	UTMHEM	N	N	Northern Hemisphere
	RLAT0	-	0N	Latitude of Projection Origin (Not Used)
	RLON0	-	0E	Longitude of Projection Origin (Not Used)
	XLAT1	-	0N	Latitude of 1st Parallel (Not Used)
	XLAT2	-	0N	Latitude of 2nd Parallel (Not Used)
	DATUM	WGS-84	NAR-C	
	NX	-	104	Number of X grid cells
	NY	-	104	Number of Y grid cells
	NZ	-	8	Number of vertical grid cells
	DGRIDKM	-	0.5	Grid spacing in X and Y directions (km)
	ZFACE	-	0, 20, 40, 80, 160, 320, 600, 1400, 2600	Vertical cell face heights of the NZ vertical layers
	XORIGKM	-	388.0	Reference Easting of SW corner of SW grid cell in UTM (km)
	YORIGKM	-	5980.0	Reference Northing of SW corner of SW grid cell in UTM (km)
	IBCOMP	-	1	X index of lower left grid cell for computation
	JBCOMP	-	1	Y index of lower left grid cell for computation
	IECOMP	-	104	X index of upper right grid cell for computation
	JECOMP	-	104	Y index of upper right grid cell for computation
	LSAMP	T	F	Sampling grid is not used
	IBSAMP	-	1	X index of lower left grid cell for sampling
	JBSAMP	-	1	Y index of lower left grid cell for sampling
	IESAMP	-	104	X index of upper right grid cell for sampling
	JESAMP	-	104	Y index of upper right grid cell for sampling
	MESHDN	1	1	Nesting factor of sampling grid

Input Group	Parameter	USEPA Default	Selected for Project	Description
Group 5: Output Options	ICON	1	1	Create binary concentration output file
	IDRY	1	1	Create binary dry flux output file
	IWET	1	1	Create binary wet flux output file
	IT2D	0	0	Do not create 2D temperature output file
	IRHO	0	0	Do not create 2D density output file
	IVIS	1	0	Output file containing relative humidity is not created
	LCOMPRS	T	T	Apply data compression
	IQAPLOT	1	1	Create a standard series of output files
	IMFLX	0	0	Diagnostic mass flux option not applied
	IMBAL	0	0	Do not report hourly mass balance for each species
	ICPRT	0	1	Do print concentrations to list file
	IDPRT	0	0	Do not print dry fluxes to list file
	IWPRT	0	0	Do not print wet fluxes to list file
	ICFRQ	1	24	Concentration print interval in hours
	IDFRQ	1	24	Dry flux print interval in hours
	IWFRQ	1	24	Wet flux print interval in hours
	IPRTU	1	3	Output units are μg/m3 for concentration and μg/m2/s for fluxes
	IMESG	2	2	Track progress of run on screen
	-	SO_2		Concentrations printed and saved on disk, dry and wet fluxes saved on disk
	-	SO_4		Concentrations saved on disk, dry and wet fluxes saved on disk
	-	NO		
	-	NO_2		
	-	HNO_3		
	-	NO_3		
		PM1		
		PM2		
		PM3		
		CO		
		NO_X		
		H_2S		
		VOC		
	LDEBUG	F	F	Do not print debug data
	IPFDEB	1	1	Debug options - First puff to track
	NPFDEB	1	1	Debug options - Number of puffs to track

Input Group	Parameter	USEPA Default	Selected for Project	Description
	NN1	1	1	Debug options - Met period to start output
	NN2	10	10	Debug options - Met period to end output
Group 6: Subgrid Scale Complex Terrain Inputs	NHILL	0	0	Number of terrain features
	NCTREC	0	0	Number of complex terrain receptors
	MHILL	-	2	Hill data created by OPTHILL
	XHILL2M	1	1	Horizontal conversion factor to meters
	ZHILL2M	1	1	Vertical conversion factor to meters
	XCTDMKM	-	0	CTDM X origin relative to CALPUFF grid
	YCTDMKM	-	0	CTDM Y origin relative to CALPUFF grid

Group 7: Chemical Parameters for Dry Deposition of Gases		Diffusivity	Alpha Star	Reactivity	Mesophyll Resistance	Henry's Law Coefficient
	SO_2	0.1509	1000	8.0	0.0	0.4
	NO	0.1345	1	2.0	25.0	18.0
	NO_2	0.1656	1	8.0	5.0	3.5
	HNO_3	0.1628	1	18.0	0.0	0.0000001

Group 8: Size Parameters for Dry Deposition of Particles		Geometric Mass Mean	Geometric Standard Deviation
	SO_4	0.48	2.0
	NO_3	0.48	2.0
	PM1	20.0	1.2418578
	PM2	5.0	1.2418578
	PM3	1.25	1.2418578

Group 9: Miscellaneous Dry Deposition Parameters				
	RCUTR	30	30	Reference cuticle resistance
	RGR	10	5	Reference ground resistance
	REACTR	8	8	Reference contaminant reactivity
	NINT	9	9	Number of particle size intervals used to evaluate effective particle deposition velocity
	IVEG	1	1	Vegetation in unirrigated areas is active and unstressed

Group 10: Wet Deposition Parameters		Liquid Precip Coef.	Frozen Precip Coef.
	SO_2	3.0E-05	0.0E00
	SO_4	1.0E-04	3.0E-05
	NO	2.9E-05	0.0E00
	NO_2	5.1E-05	0.0E00
	HNO_3	6.0E-05	0.0E00
	NO_3	1.0E-04	3.0E-05
	PM1	6.6E-0.4	6.6E-0.4

Input Group	Parameter	USEPA Default	Selected for Project	Description
	PM2	3.6E-0.4		3.6E-0.4
	PM3	0.64E-04		0.64E-04
Group 11: Chemistry Parameters	MOZ	1	0	Monthly ozone values are used in chemistry
	BCKO3	12*80	12*17.8	Monthly ozone values are used in chemistry (17.8 for each month)
	BCKNH3	12*10	12*0.5	Constant background concentration in ppb (0.5 for each month_
	RNITE1	0.2	0.2	Night time SO_2 loss rate (% per hour)
	RNITE2	2	2	Night time NO_X loss rate (% per hour)
	RNITE3	2	2	Night time HNO_3 formation rate (% per hour)
	BCKH2O2	12*1	12*1	Background H2O2 (Not Used)
	BCKPMF	12*1	12*1	Background fine particulate matter (Not Used)
	OFRAC	12*0.20	9*0.20 3*0.15	Organic fraction of fine particulate matter (Not Used)
	VCNX	12*50	12*50	VOC/NO_X ratio for chemistry (Not Used)
Group 12: Miscellaneous Dispersion and Computational Parameters	SYTDEP	550	550	Horizontal size of puff in meters beyond which Heffer dispersion is applied
	MHFTSZ	0	0	Do not use Heffer formulas for sigma Z
	JSUP	5	5	Stability class used to determine plume growth rates for puff above the boundary layer
	CONK1	0.01	0.01	Vertical dispersion constant for stable conditions
	CONK2	0.1	0.1	Vertical dispersion constant for neutral/unstable conditions
	TBD	0.5	0.5	Transition factor between Huber-Snyder and Schulman-Scire downwash schemes
	IURB1	10	10	Lower range of land use categories for which urban dispersion is assumed
	IURB2	19	19	Upper range of land use categories for which urban dispersion is assumed
	ILANDUIN	20	20	Land use category for modelling domain

Input Group	Parameter	USEPA Default	Selected for Project	Description
	ZOIN	0.25	0.25	Roughness length in meters for domain
	XLAIIN	3	3	Leaf area index for domain
	ELEVIN	0	0	Elevation above sea level in meters
	XLATIN	-999	0	Latitude of met location in degrees
	XLONIN	-999	0	Longitude of met location in degrees
	ANEMHT	10	10	Anemometer height in meters
	ISIGMAV	1	1	Read sigma-v from profile file (Not Used)
	IMIXCTDM	0	0	Predicted mixing heights are used
	XMXLEN	1	1	Maximum slug length
	XSAMLEN	1	1	Maximum travel distance of a puff in grid units during one sampling step
	MXNEW	99	99	Maximum number of puffs released from one source during one sampling step
	MXSAM	99	99	Maximum number of sampling steps during one time step for a puff
	NCOUNT	2	2	Number of iterations used when computing the transport wind for a sampling step that includes transitional plume rise
	SYMIN	1	1	Minimum sigma Y in metres for a new puff
	SZMIN	1	1	Minimum sigma Z in metres for a new puff
	SVMIN (Land&Water)	0.5,0.5,0.5 0.5,0.5,0.5, 0.37,0.37, 0.37,0.37, 0.37,0.37	0.5,0.5,0.5 0.5,0.5,0.5, 0.37,0.37, 0.37,0.37, 0.37,0.37	Default minimum turbulence velocities for each stability class (Sigma-V)
Group 12: Miscellaneous Dispersion and Computational Parameters (cont'd)	SWMIN (Land&Water)	0.2,0.12, 0.08,0.06, 0.03,0.016, 0.2,0.12 0.08,0.06 0.03,0.016	0.2,0.12, 0.08,0.06, 0.03,0.016, 0.2,0.12 0.08,0.06 0.03,0.016	Default minimum turbulence velocities for each stability class (Sigma-W)
	CDIV	0, 0	0, 0	Divergence criteria for dw/dz in meters

Input Group	Parameter	USEPA Default	Selected for Project	Description
	WSCALM	0.5	0.5	Minimum wind speed allowed for non-calm conditions in m/s
	XMAXZI	3000	3000	Maximum mixing height in meters
	XMINZI	50	20	Minimum mixing height in meters
	WSCAT	1.54, 3.09, 5.14, 8.23, 10.8	1.54, 3.09, 5.14, 8.23, 10.8	Wind Speed Class
	PLX0	0.07, 0.07, 0.10, 0.15, 0.35, 0.55	0.07, 0.07, 0.10, 0.15, 0.35, 0.55	Wind speed profile power-law exponents for stabilities 1 to 6
	PTG0	0.02, 0.035	0.02, 0.035	Potential temperature gradient for stable classes
	PPC	0.5, 0.5, 0.5, 0.5, 0.35, 0.35	0.5, 0.5, 0.5, 0.5, 0.35, 0.35	Plume path coefficients for partial plume path adjustment terrain method.
	SL2PF	10	10	Slug to puff transition factor (Not used)
	NSPLIT	3	3	Number of puffs that result everytime a puff is split (Not used)
	IRESPLIT	0,0,0,0,0,0,0 0,0,0,0,0,0,0 0,0,0,1,0,0,0 0,0,0	0,0,0,0,0,0,0 0,0,0,0,0,0,0 0,0,0,1,0,0,0 0,0,0	Times of day when puff can be split after being split previously (Not used)
	ZISPLIT	100	100	Puff split only occurs if previous hours mixing height exceeds this value (Not used)
	ROLDMAX	0.25	0.25	Maximum allowable ratio previous hour mixing height to maximum mixing height experience by puff (Not used)
	NSPLITH	5	5	Number of puffs that result from each split (not used)
	SYSPLITH	1	1	Minimum sigma-y off puff before it may be split (Not used)
	SHSPLITH	2	2	Minimum puff elongation rate due to wind shear, before it may be split (Not used)
	CNSPLITH	1.0E-07	1.0E-07	Minimum concentration (g/m3) of each species in puff before it may be split (Not used)
	EPSSLUG	1.0E-04	1.0E-04	Fraction convergence criterion for numerical slug sampling integration
	EPSAREA	1.0E-06	1.0E-06	Fraction convergence criterion for numerical area sources integration
	DSRISE	1	1	Trajectory step-length (m) used for numerical rise integration

Input Group	Parameter	USEPA Default	Selected for Project	Description
	HTMINBC	500	500	Min height to mix boundary condition puffs (m)
	RSAMPBC	10	10	Search radius (BC length segments) about a receptor for sampling nearest BC puff.
	NDEPBC	1	1	Near surface depletion adjustment when sampling BC puffs
Group 13: Point Source Parameters	NPT1	-	24	Number of point sources modelled (Project Alone)
	IPTU	1	1	Units used for emissions (g/s)
	NSPT1	0	0	Number of source-species combinations with variable emissions scaling factors
	NPT2	-	0	Number of point sources with variable emissions
Group 14: Area Source Parameters	NAR1	-	0	Number of polygon area sources modelled
	IARU	1	1	Units used for emissions (g/m2/s)
	NSAR1	0	0	Number of source-species combinations with variable emissions scaling factors
	NAR2	-	0	Number of area sources with variable emissions
Group 15: Line Source Parameters	NLN2	-	0	Number of buoyant line sources with variable location and emission parameters
	NLINES	-	0	Number of buoyant line sources
	ILNU	1	1	Units for line source emission rates is g/s
	NSLN1	0	0	Number of source-species combinations with variable emission scaling factors
	MXNSEG	7	7	Maximum number of segments used to model each line
	NLRISE	6	6	Number of distances at which transitional rise computed
	XL	-	0	Average building length
	HBL	-	0	Average building height
	WBL	-	0	Average building width
	WML	-	0	Average line sources width
	DXL	-	0	Average separation between buildings
	FPRIMEL	-	0	Average buoyancy parameter
Group 16:	NVL1	-	0	Number of volume sources applied

Input Group	Parameter	USEPA Default	Selected for Project	Description
Volume Source Parameters	IVLU	1	1	Units used for volume sources (g/s)
	NSVL1	0	0	Number of source-species combinations with variable emission scaling factors
	NSVL2	-	0	Number of volume sources with variable location and emission parameters
Group 17: Non-Gridded Receptor Information	NREC	-	10223	Number of non-gridded discrete receptors that compose the series of nested grids and project boundary

3 AMMONIA AND OZONE CONCENTRATIONS

The CALPUFF chemistry schemes used in this Project requires the specifications of ambient ammonia (NH_3) and ozone (O_3) concentrations present in the model domain. From the Sulphur Dioxide Technical Assessment Report for the Kitimat Modernization Project an annual average NH_3 concentration of 0.5 ppb (parts per billion) was used for each month (ESSA 2013). O_3 data is measured in the district of Kitimat at the Kitimat City Center Mobil Air Monitoring Laboratory (MAML) station. The data is considered to represent similar O_3 levels in the Project area and is from the closest O_3 monitoring station to the Project site. The data set from the BC MOE operated station does not contain a full year of monthly O_3 data. Therefore an average of 17.8 ppb was used to represent the monthly concentrations of O_3.

4 CHEMICAL TRANSFORMATIONS

The RIVAD/ARM3 chemistry scheme (MCHEM=3) treats the NO and NO_2 oxidation process in addition to the NO_2 to NO_3 and SO_2 to SO_4 chemical transformations, with equilibrium between gaseous HNO_3 and particulate NH_4NO_3 (Scire et al. 1999). The chemical transformation scheme requires both NO and NO_2 emissions rates. Typically, only the NO_x emission rate is known, and this is expressed in terms of NO_2 mass equivalent. Based on the NO_x emission rate, the individual NO and NO_2 emission rates were calculated as follows:

$$90\%\ NO\ and\ 10\%\ NO_2\ on\ a\ volume\ basis$$

$$NO_{mass\ emission}(g/s) = 0.9 \times \left(\frac{30}{46}\right) \times NO_{x\ mass\ emission}$$

$$NO_{2\ mass\ emission}(g/s) = 0.1 \times \left(\frac{46}{46}\right) \times NO_{x\ mass\ emission}$$

These assumptions result in 85% NO and 15% NO2 emission on a mass basis.

The RIVAD/ARM3 chemistry scheme was applied relative to the prediction of sulphate and nitrate compounds to calculate the deposition rates of total sulphates and total nitrates. The post processing tool, POSTUTIL Version 1.52, was used to calculate the total sulphate and nitrate deposition as follows:

$$N_{dep}(\mu g/m^2/s) = 1.35 \times [NO] + 1.35 \times [NO_2] + 0.98 \times [HNO_3] + [NO_3]$$

$$S_{dep}\ (\mu g/m^2/s) = 1.5 \times [SO_2] + [SO_4]$$

The N_{dep} and S_{dep} deposition rates are used in the calculation for potential acid input (PAI). The N_{dep} deposition rates inform the eutrophication ecosystem analysis, vegetation resources (Appendix E), soils (Appendix G), and freshwater aquatic resources (Appendix I) sections of the PNW LNG Environment Assessment Certificate Application EA.

5 PARTICULATE FORMATION

CALPUFF treats total particulate matter (TPM), inhalable particulate matter < 10 µm (PM_{10}), and respirable particulate matter < 2.5 µm ($PM_{2.5}$) as independent species. These size components are actually not independent and are interconnected. For this reason 3 bins, PM1, PM2, and PM3 were used as emission rate inputs in CALPUFF instead of the TPM, PM_{10}, and $PM_{2.5}$ emission rates (Government of NL 2012). The calculations of PM1, PM2, and PM3 from the TPM, PM_{10}, and $PM_{2.5}$ emission rates are as follows:

$$PM1\ (g/s) = TSP - PM_{10}$$

$$PM2\ (g/s) = PM_{10} - PM_{2.5}$$

$$PM3\ (g/s) = PM_{2.5}$$

With this method the size groups are a more uniform size. Using the predicted concentrations of PM1, PM2, and PM3 POSTUTIL calculates the predicated TSP, PM_{10}, and $PM_{2.5}$:

$$TSP\ (\mu g/m^3) = PM1 + PM2 + PM3$$

$$PM_{10}(\mu g/m^3) = PM2 + PM3$$

$$PM_{2.5}\ (\mu g/m^3) = PM3$$

The CALPUFF model was used to predict secondary $PM_{2.5}$ due to precursor SO_2 and NO_x. Using the RIVAD/ARM3 scheme described above the model predicts particulate nitrate NO_3^-, which can exist as an aerosol (i.e., dissolved in a water droplet) or as a particle (e.g., NH_4NO_3). Similarly, sulphate SO_4^{2-} can also exist as an aerosol (i.e., dissolved in a water droplet) or as a particle (e.g., $(NH_4)_2SO_4$). NO_3^- and SO_4^{2-} are assumed to react with ambient ammonia (NH_3) to produce ammonium nitrate and ammonium sulphate, respectively; the predicted sulphate and nitrate are multiplied by the factors indicated in Table 6-4 to provide a mass equivalent to the PM species.

Table 6-4: $PM_{2.5}$ Multipliers for SO_4^{2-} and NO_3^-

Predicted Parameter	SO_4^{2-}	NO_3^-
Molecular mass	96	62
End Product	**$(NH_4)_2SO_4$**	**NH_4NO_3**
Molecular Mass	132	80
Multiplier	1.376	1.291

NOTE:
Multiplier = (Molecular Mass of End Product)/(Molecular Mass of Predicted Parameter)

Using the above calculations with PM1, PM2 and PM3 as well as the secondary particulate, total TPM, PM_{10}, and $PM_{2.5}$ concentrations are calculated as follows:

$$TSP\ (\mu g/m^3) = PM1 + PM2 + PM3 + 1.376 \times\ [SO_4] + 1.291 \times [NO_3]$$

$$PM_{10}(\mu g/m^3) = PM2 + PM3 + 1.376 \times\ [SO_4] + 1.291 \times [NO_3]$$

$$PM_{2.5}\ (\mu g/m^3) = PM3 + 1.376 \times\ [SO_4] + 1.291 \times [NO_3]$$

6 REFERENCES

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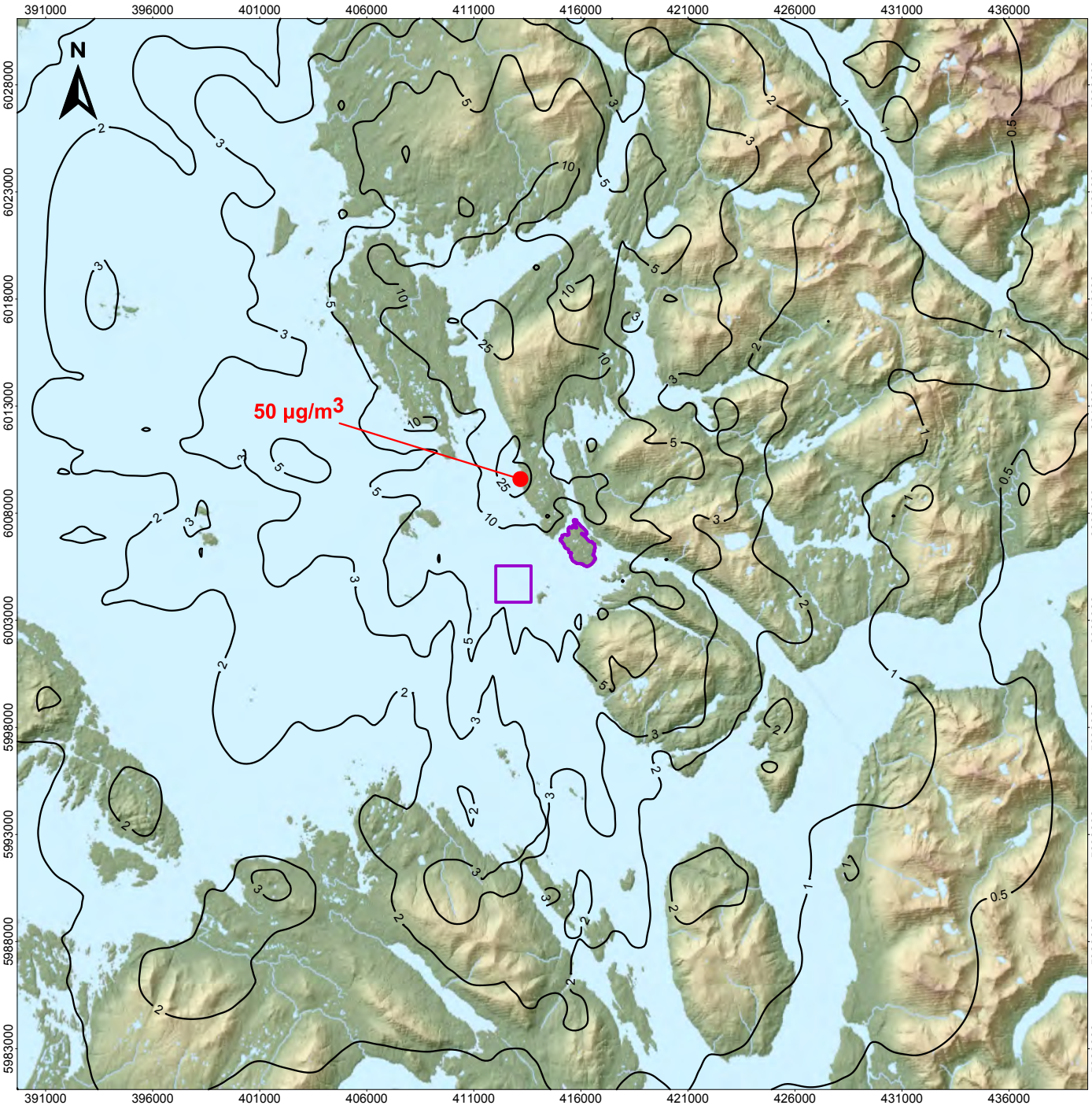
APPENDIX 7

Isopleth Figures

Pacific NorthWest LNG

Stantec

ISOPLETHS FIGURES



Maximum Concentration (µg/m³)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted 1-hour Average Ground-level SO_2 Concentrations Associated with the Baseline Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	ba_SO2_1hr	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-1**

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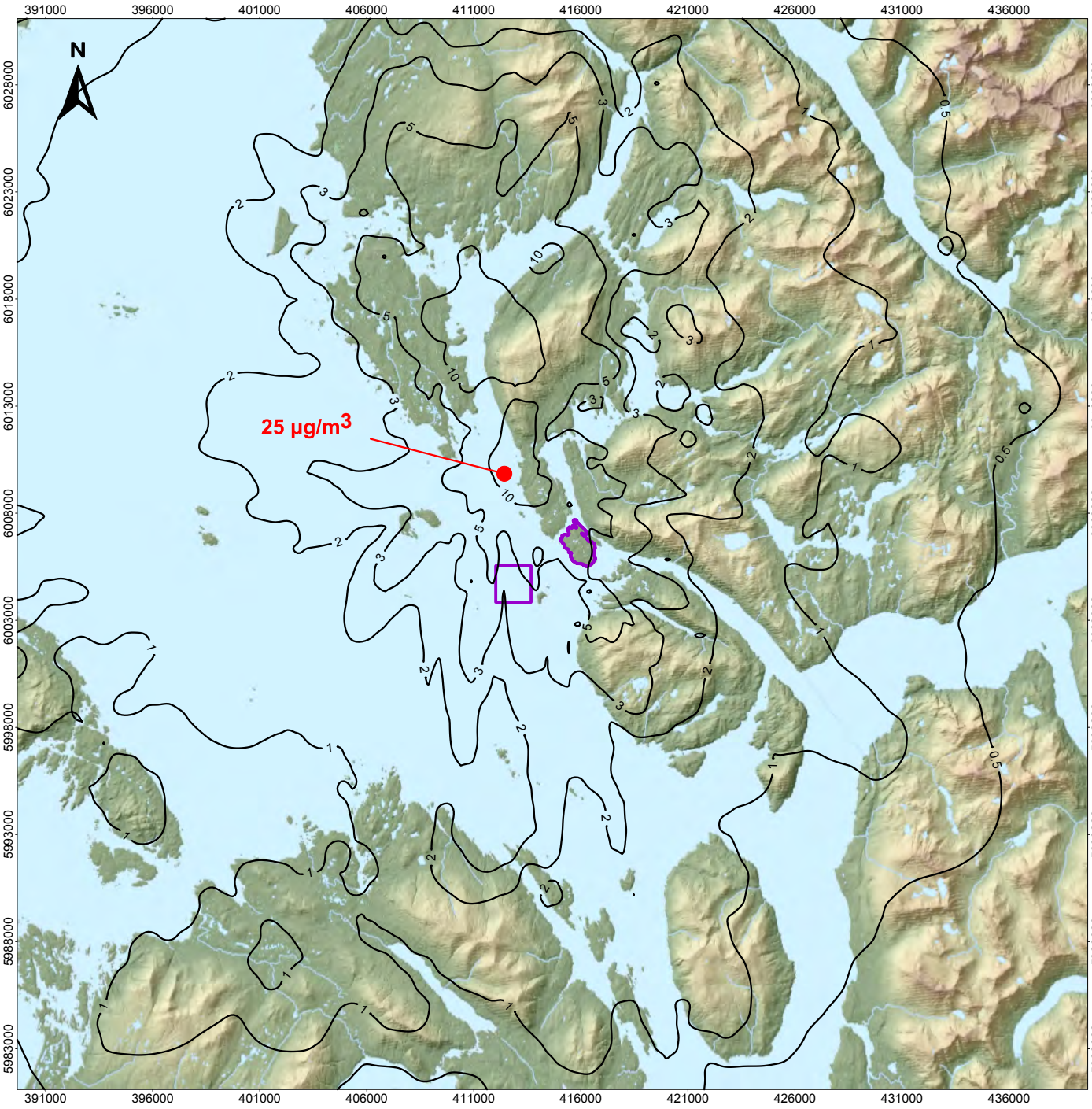

Maximum Concentration (µg/m³)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted 3-hour Average Ground-level SO_2 Concentrations Associated with the Baseline Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	ba_SO2_3hr	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-2**

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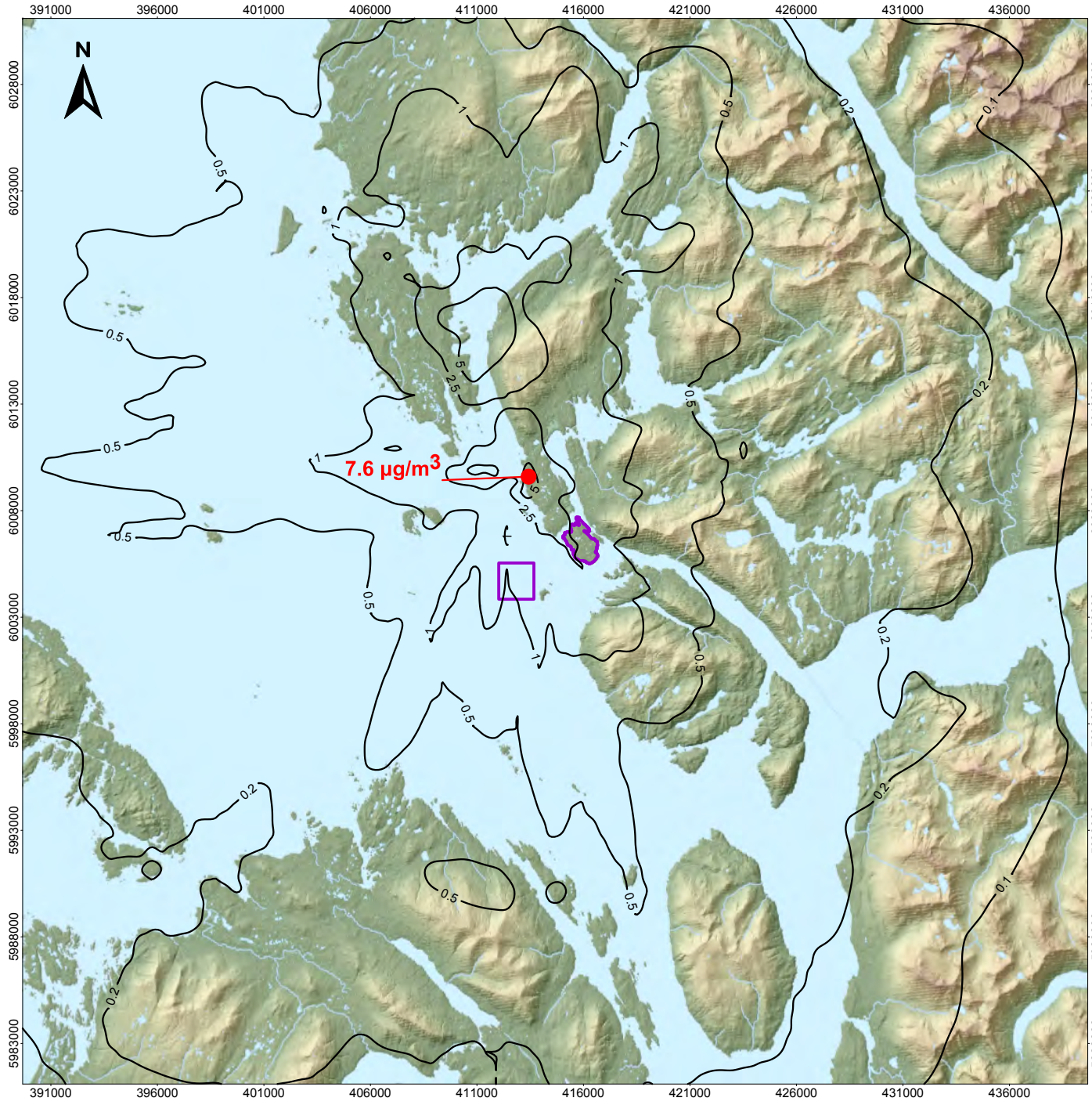


Maximum Concentration (µg/m³)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted 24-hour Average Ground-level SO_2 Concentrations Associated with the Baseline Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

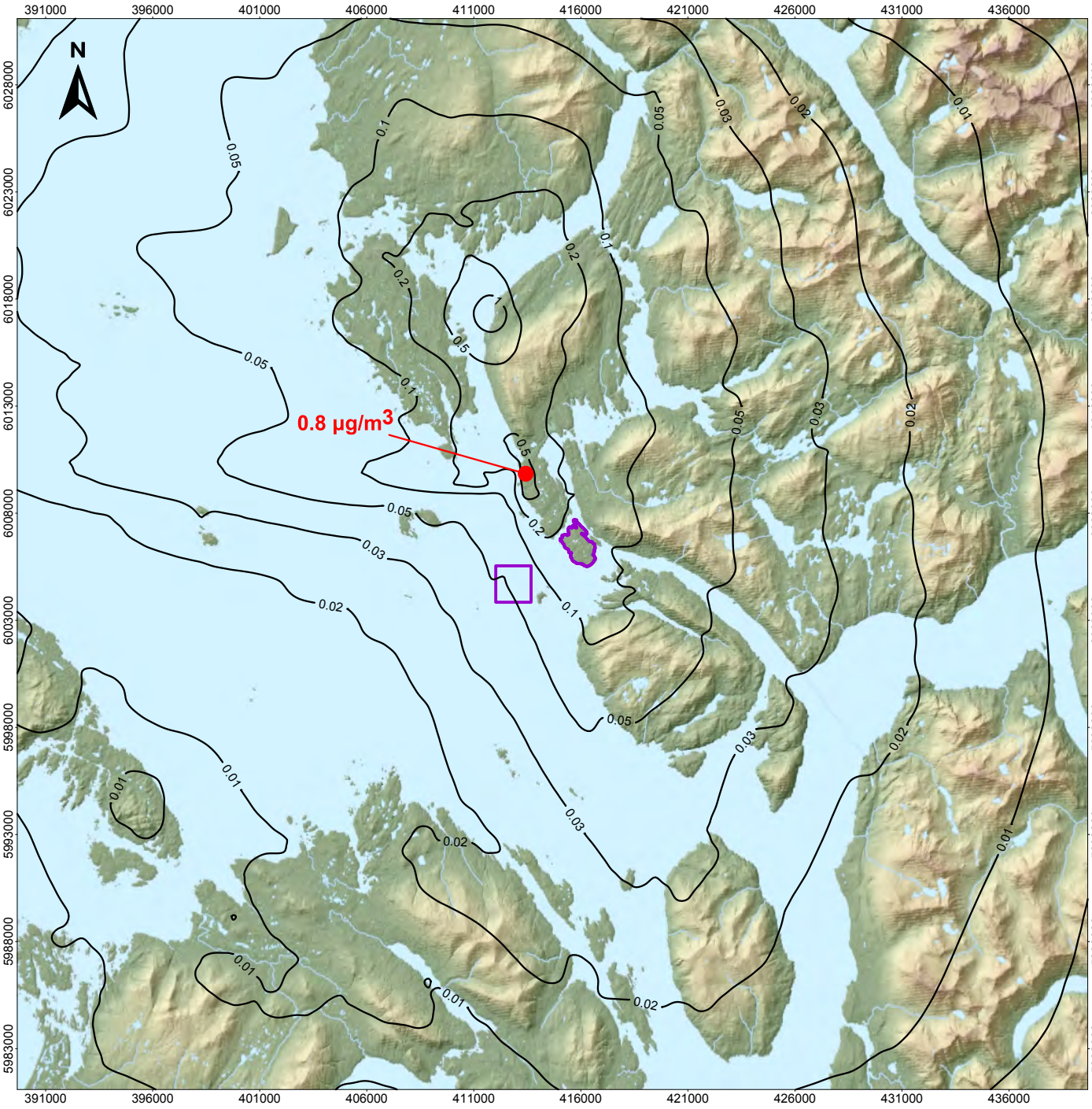
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	ba_SO2_24hr	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-3**

V:\1231\active\EM\123110537\disc_folders\air_quality\surfer\Isopleths\Baseline\ba_SO2_24hr.srf



Units: µg/m³
Annual SO_2 AAQO = 25 µg/m³

Maximum Concentration (µg/m³)
Project Boundary

Pacific NorthWest LNG

Maximum Predicted Annual Average Ground-level SO_2 Concentrations Associated with the Baseline Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	ba_SO2_ann	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-4**

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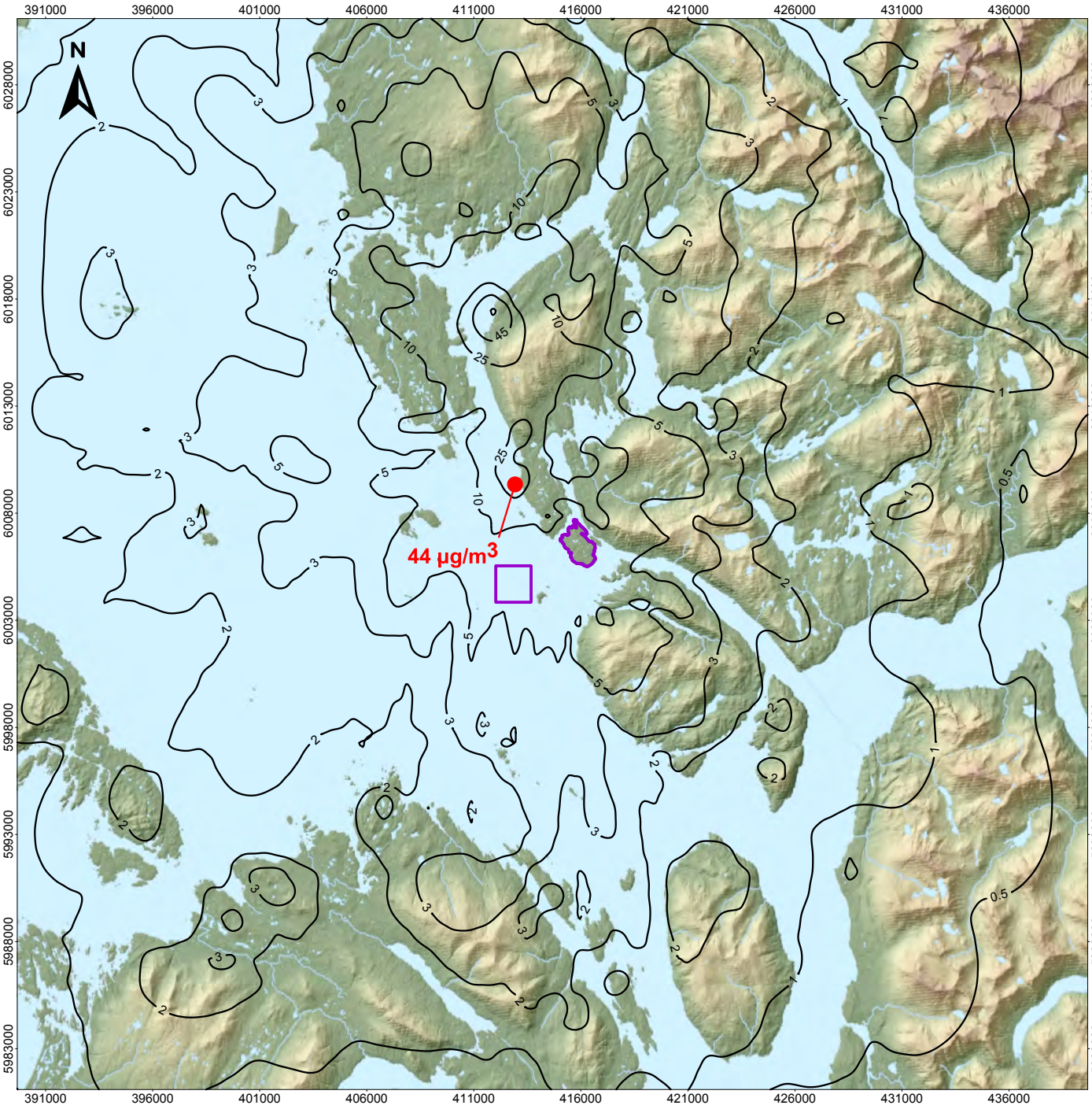

Maximum Concentration (µg/m³)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted 1-hour Average
15-metre SO_2 Concentrations
Associated with the Baseline Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	ba_SO2_1hr_15m	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-5**

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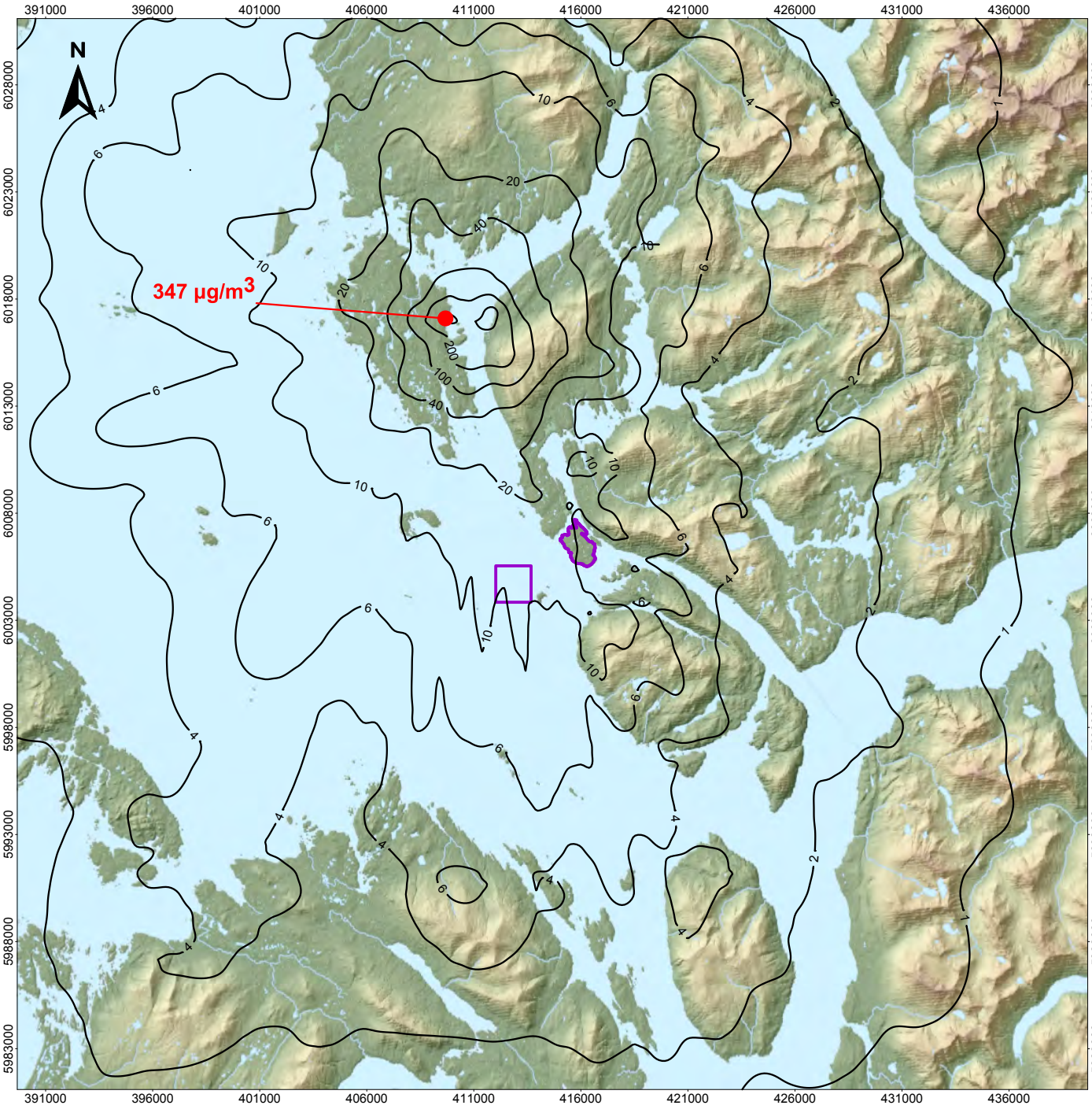

Maximum Concentration (µg/m³)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted 1-hour Average Ground-level NO_2 Concentrations Associated with the Baseline Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	ba_NO2_1hr	DATUM:	NAD 83
DRAWN BY:	K. Wells	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-6**

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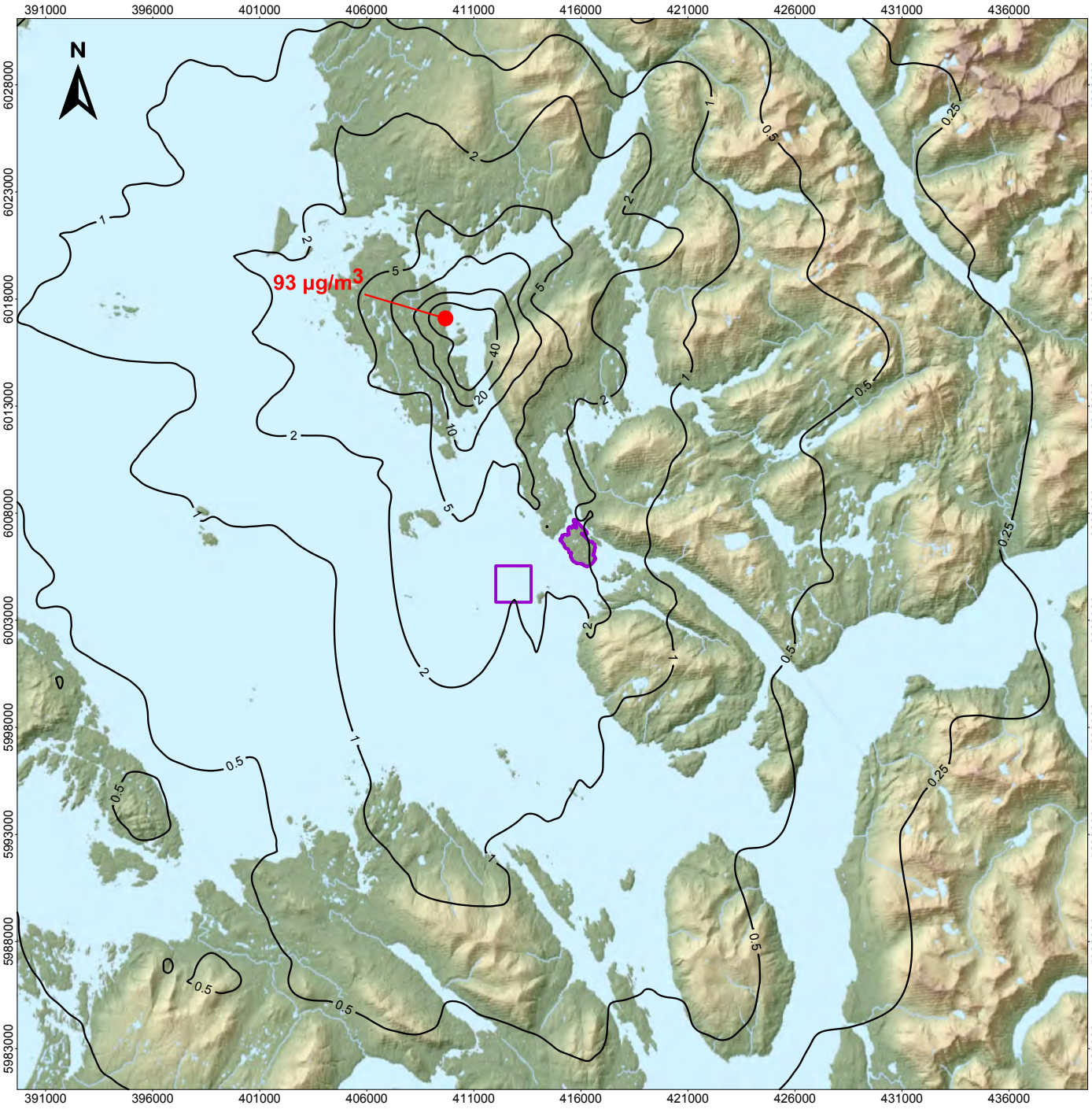

Units: µg/m³
24-hr NO_2 AAQO = 200 µg/m³

Maximum Concentration (µg/m³)
Project Boundary

Pacific NorthWest LNG
Maximum Predicted 24-hour Average Ground-level NO_2 Concentrations Associated with the Baseline Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	ba_NO2_24hr	DATUM:	NAD 83
DRAWN BY:	K. Wells	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-7**

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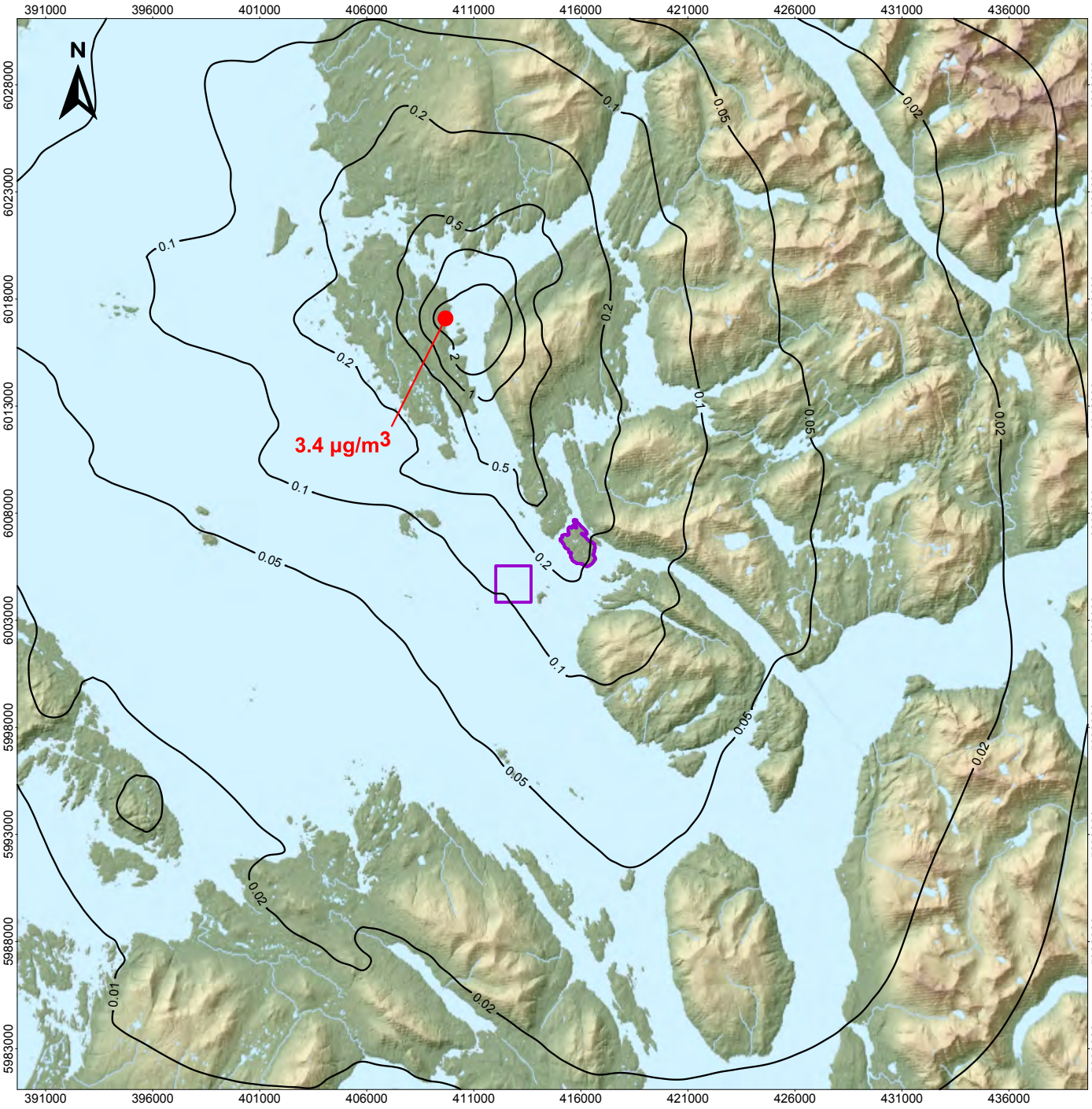

Maximum Concentration (µg/m³)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted Annual Average Ground-level NO_2 Concentrations Associated with the Baseline Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	ba_NO2_ann	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-8**

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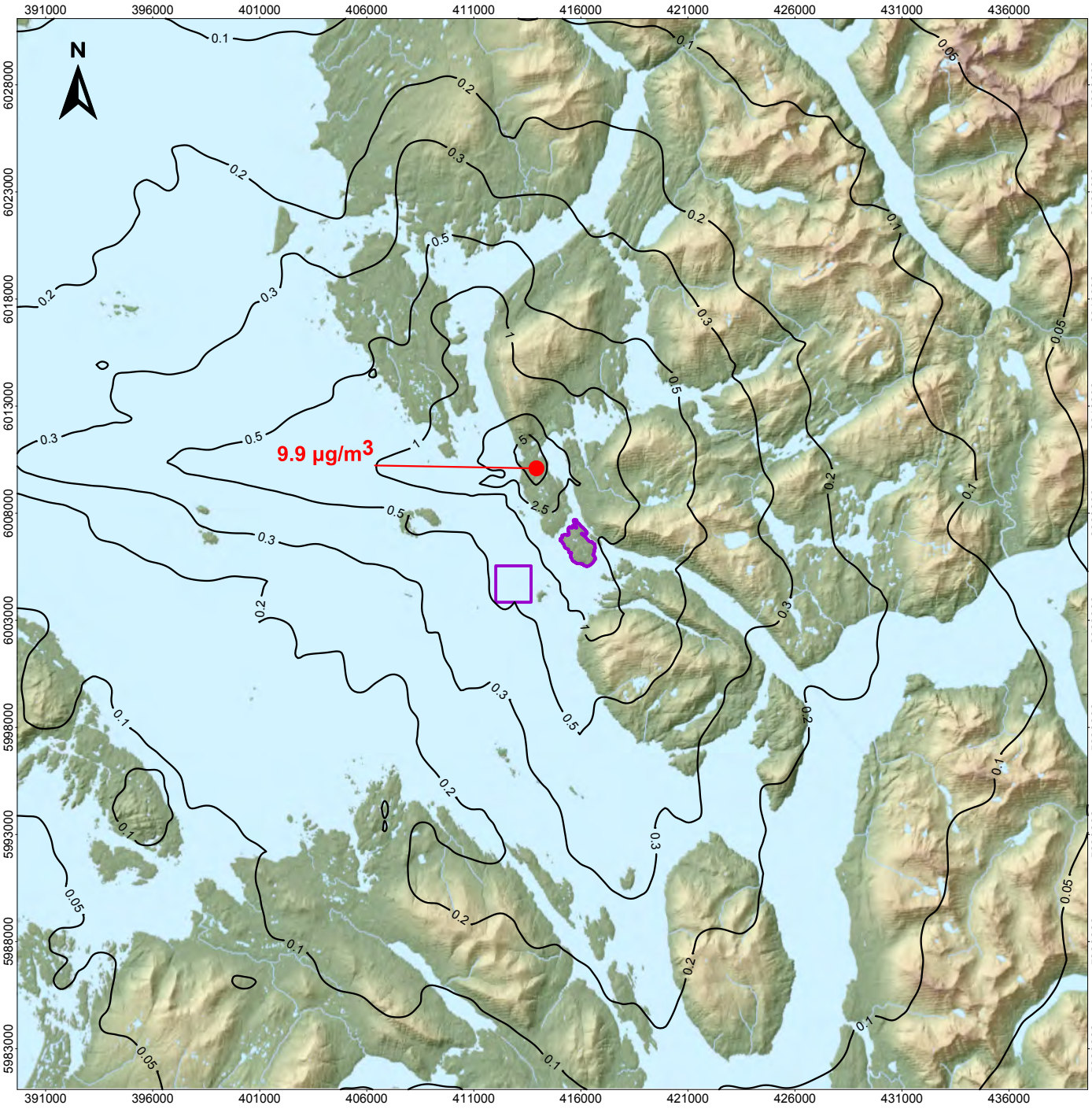

Maximum Concentration (µg/m³)

Project Boundary

Pacific NorthWest LNG

98th Percentile 24-hour Average Ground-level $PM_{2.5}$ Concentrations Associated with the Baseline Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	ba_PM2.5_24hr	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-9**

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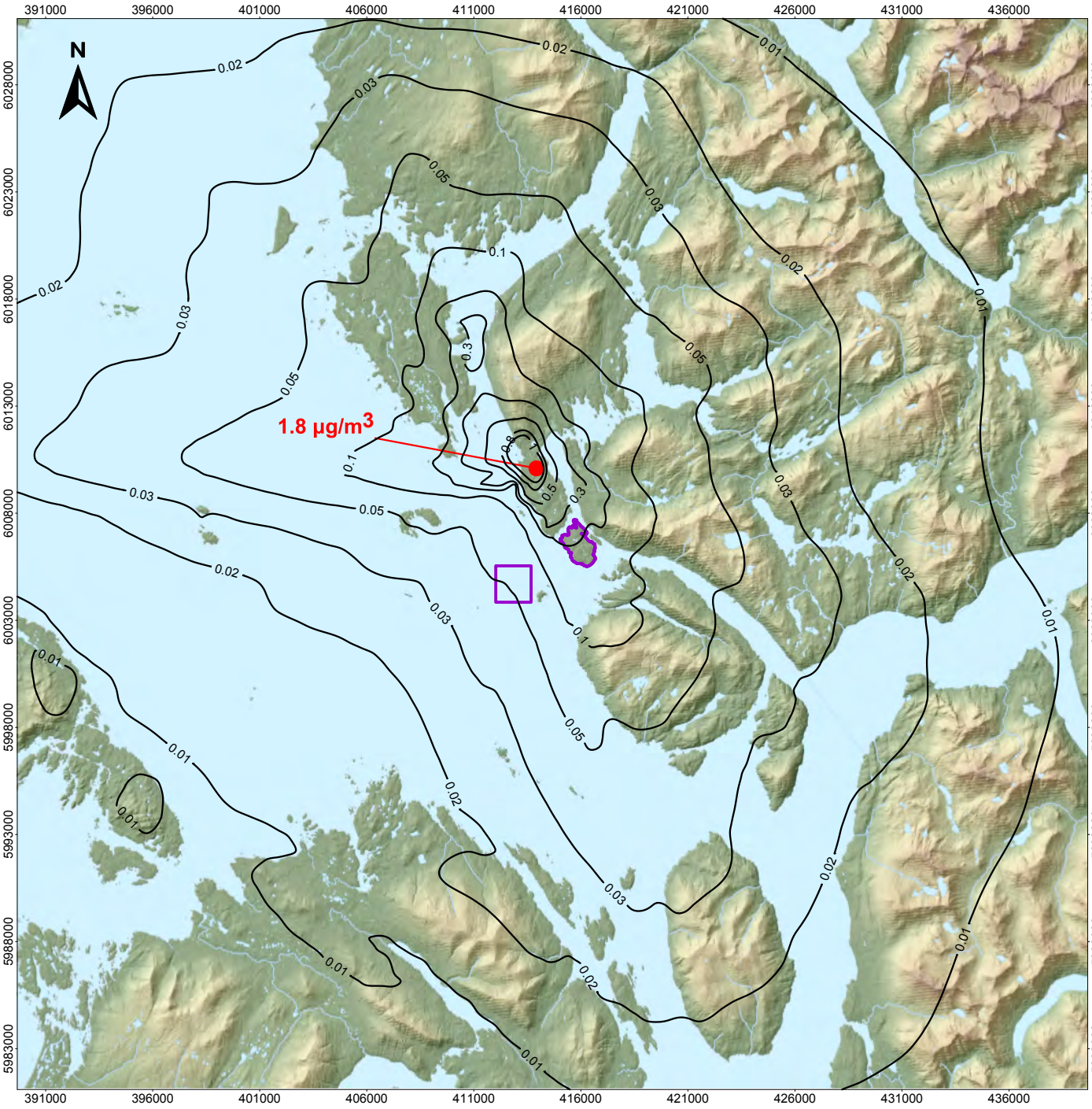

Units: µg/m³
Annual $PM_{2.5}$ AAQO = 8 µg/m³

Maximum Concentration (µg/m³)
Project Boundary

Pacific NorthWest LNG

Maximum Predicted Annual Average Ground-level $PM_{2.5}$ Concentrations Associated with the Baseline Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	ba_PM2.5_ann	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-10**

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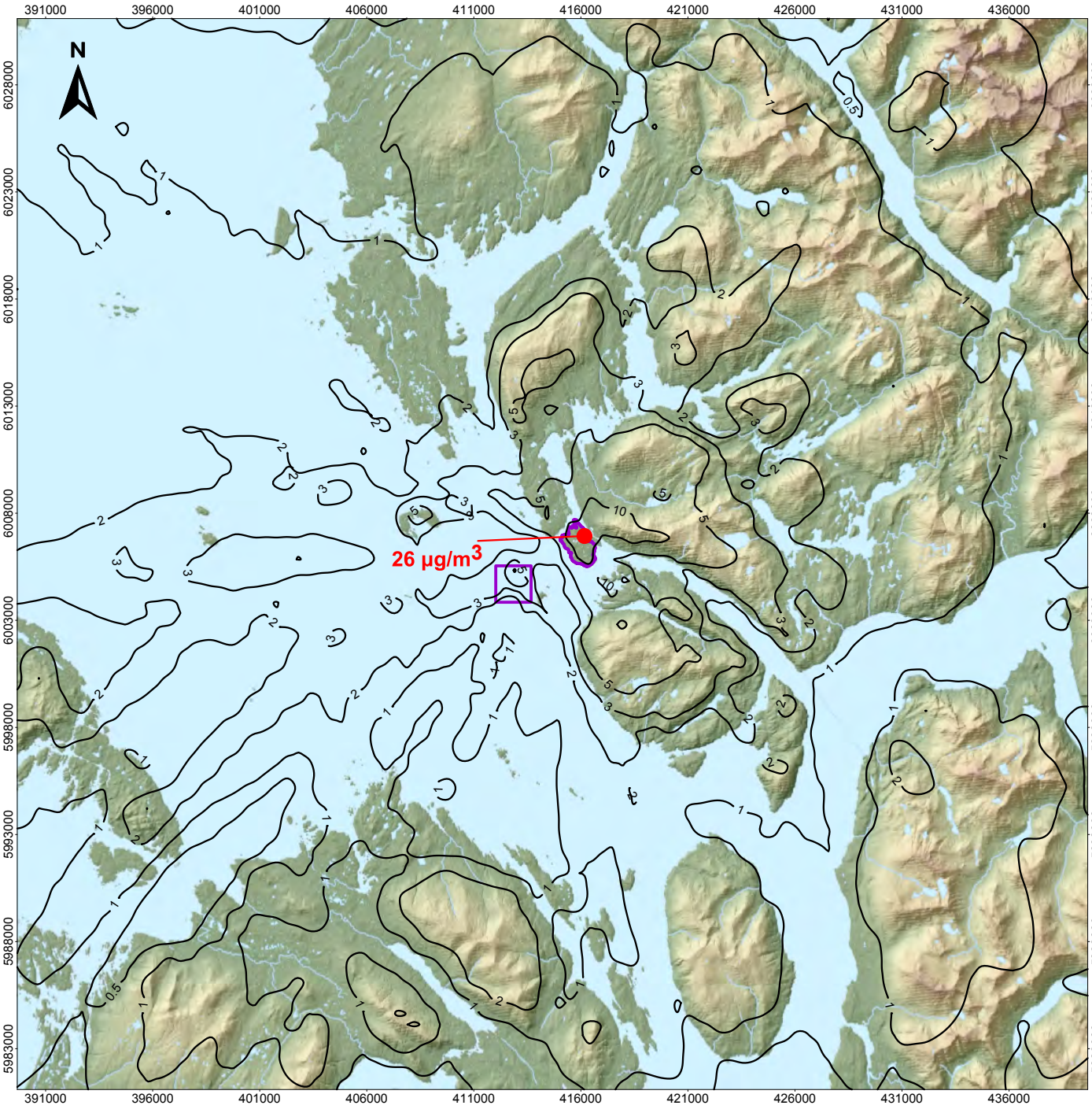

Maximum Concentration (µg/m³)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted 1-hour Average Ground-level SO_2 Concentrations Associated with the Project-alone Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	pr_SO2_1hr	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-11**

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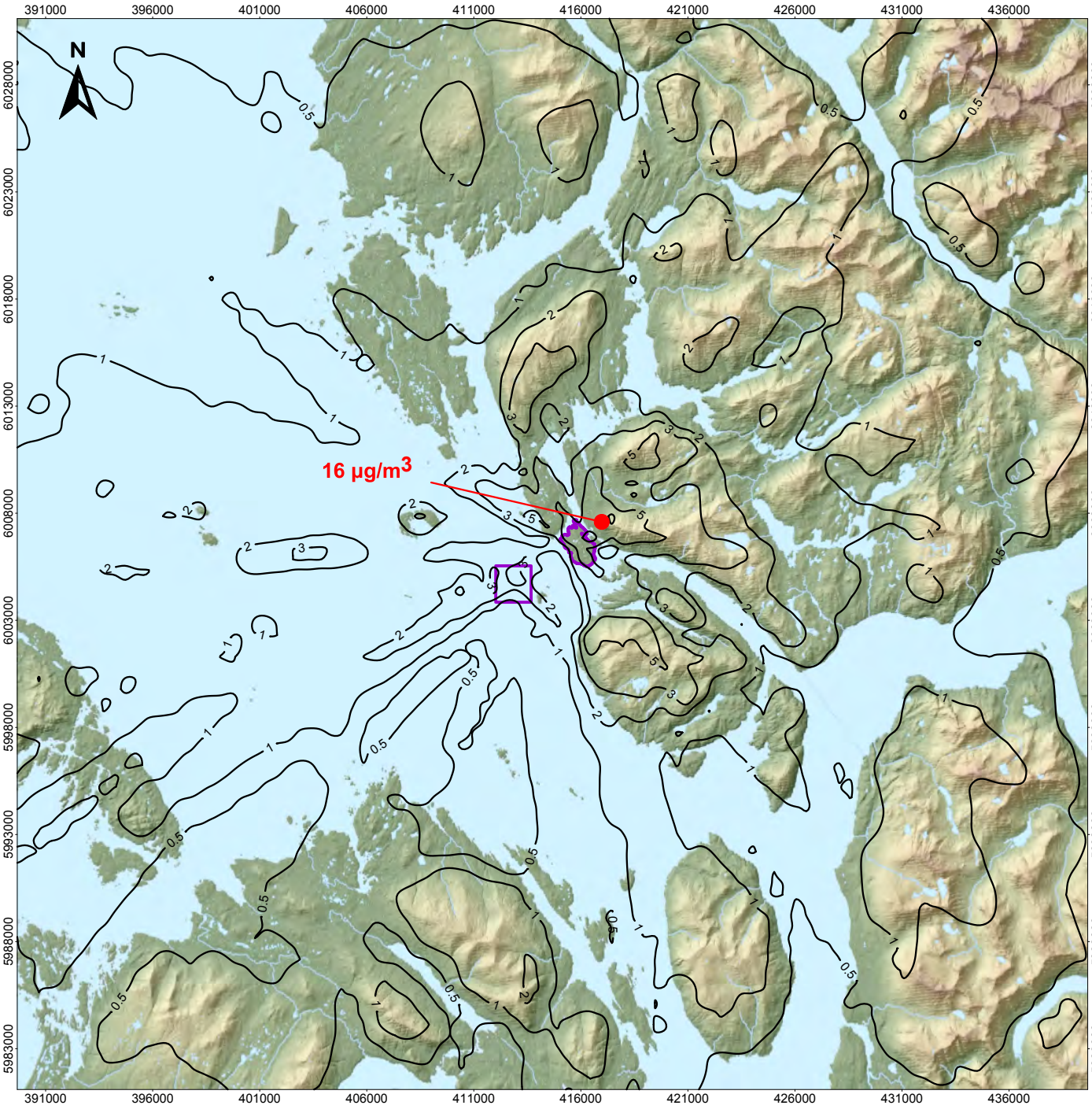

Units: µg/m³
3-hr SO_2 AAQO = 375 µg/m³

Maximum Concentration (µg/m³)
Project Boundary

Pacific NorthWest LNG

Maximum Predicted 3-hour Average Ground-level SO_2 Concentrations Associated with the Project-alone Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	pr_SO2_3hr	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-12**

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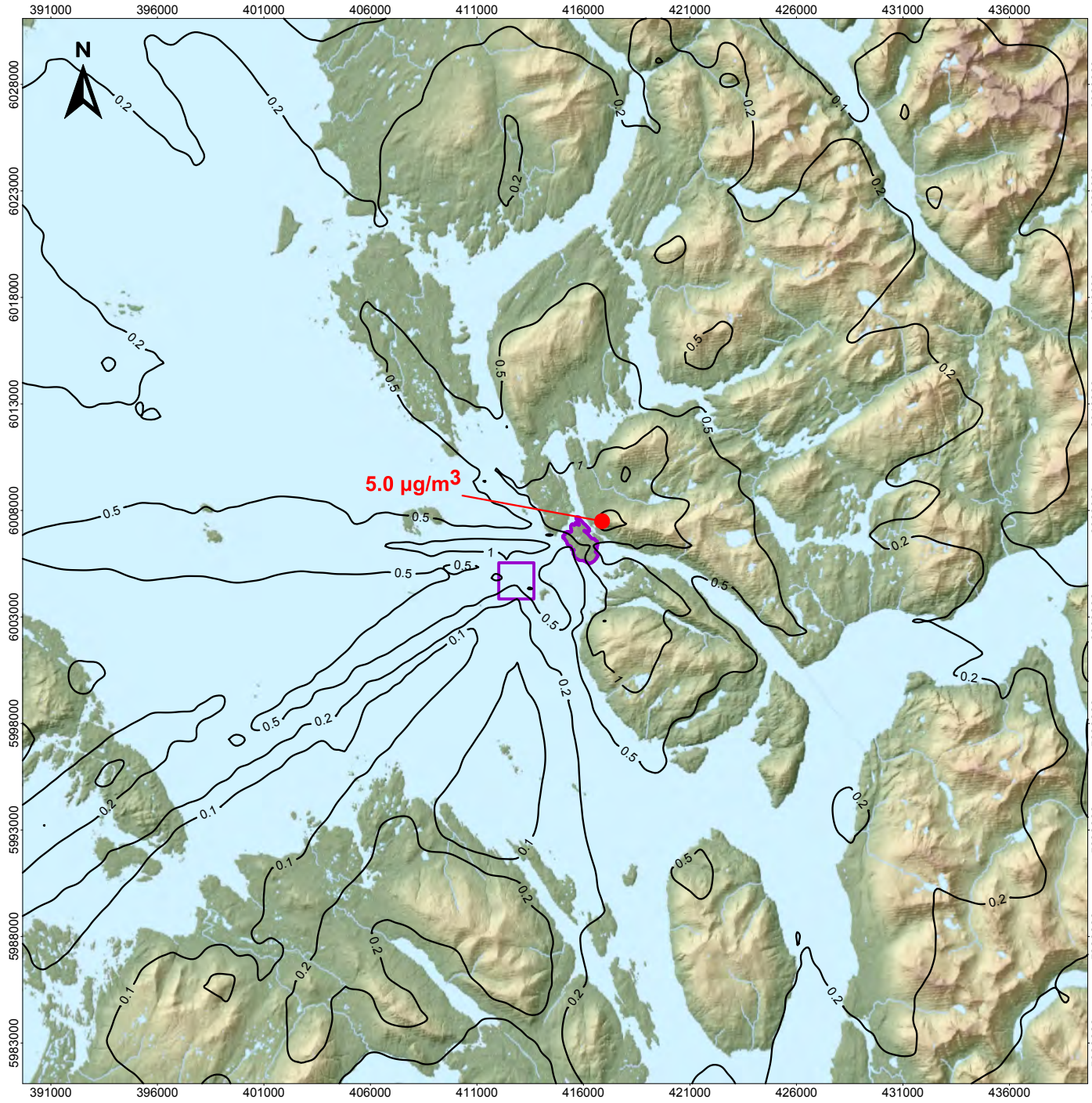


Maximum Concentration (µg/m³)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted 24-hour Average Ground-level SO_2 Concentrations Associated with the Project-alone Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

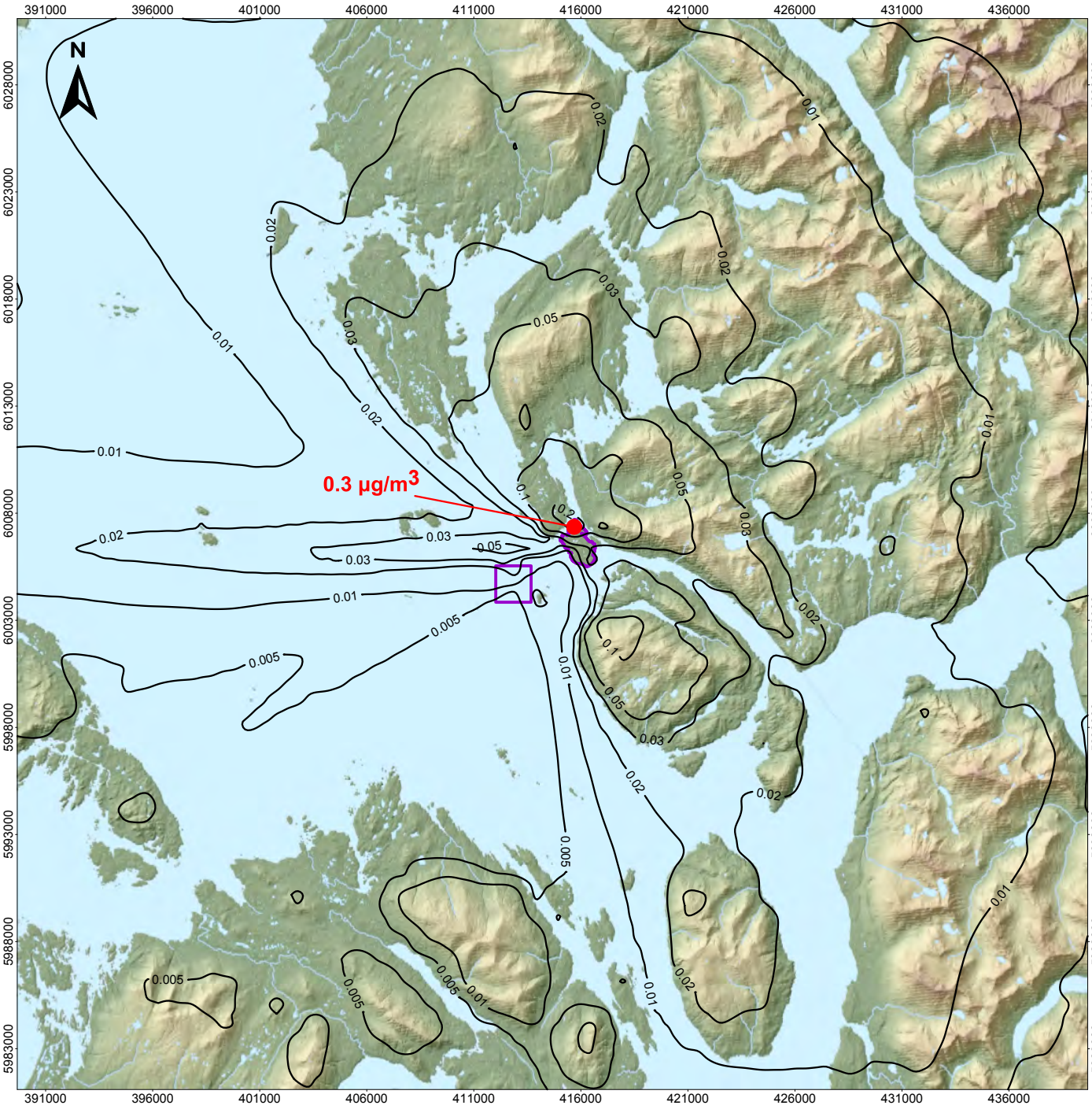
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	pr_SO2_24hr	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-13**

V:\1231\active\EM\1231 10537\disc_folders\air_quality\surfer\Isopleths\Project\pr_SO2_24hr.srf



Maximum Concentration (µg/m³)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted Annual Average Ground-level SO_2 Concentrations Associated with the Project-alone Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

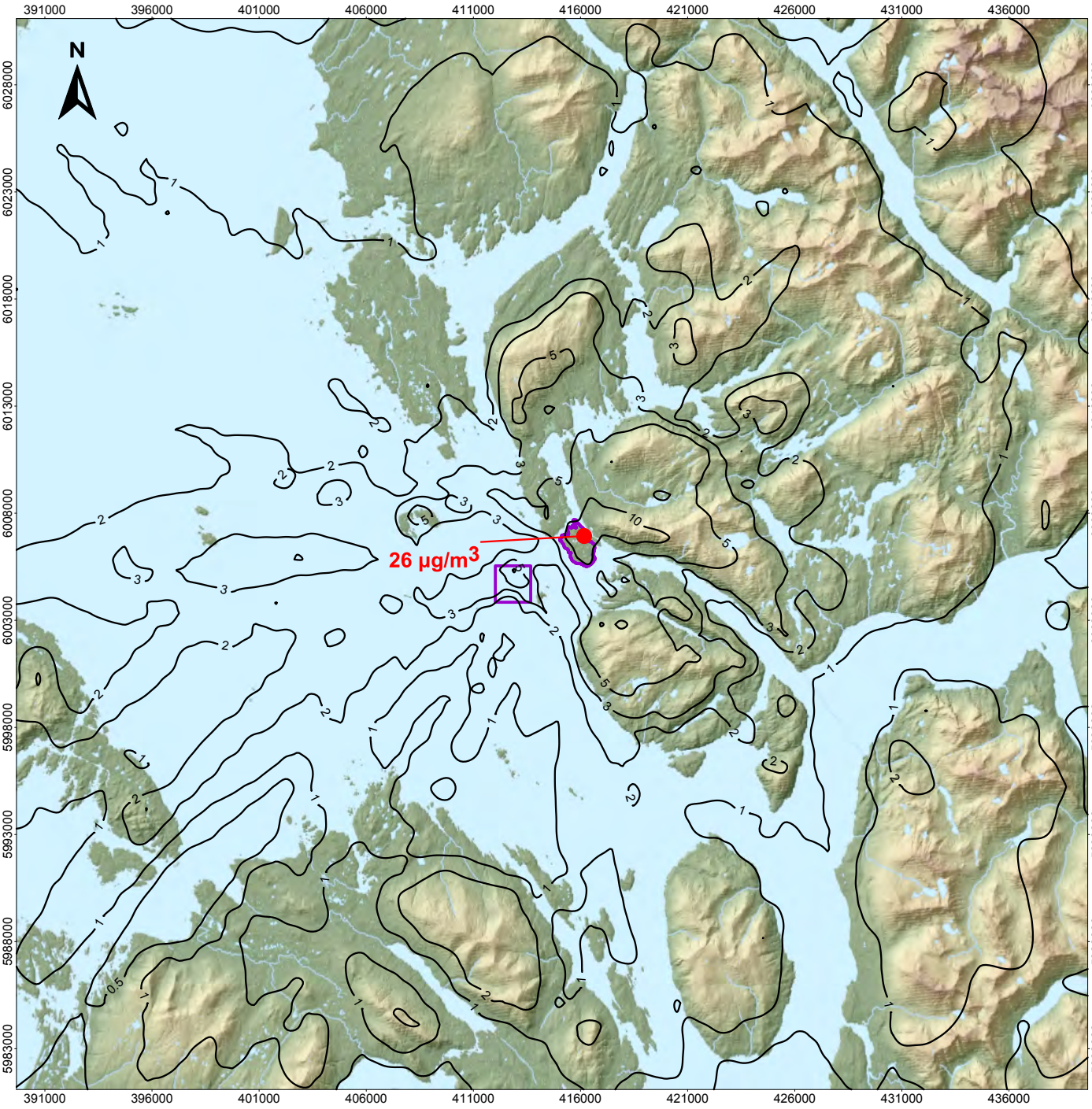
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	pr_SO2_ann	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-14**

V:\1231\active\EM\1231 10537\disc_folders\air_quality\surfer\Isopleths\Project\pr_SO2_ann.srf



Maximum Concentration (µg/m³)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted 1-hour Average
15-metre SO_2 Concentrations
Associated with the Project-alone Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

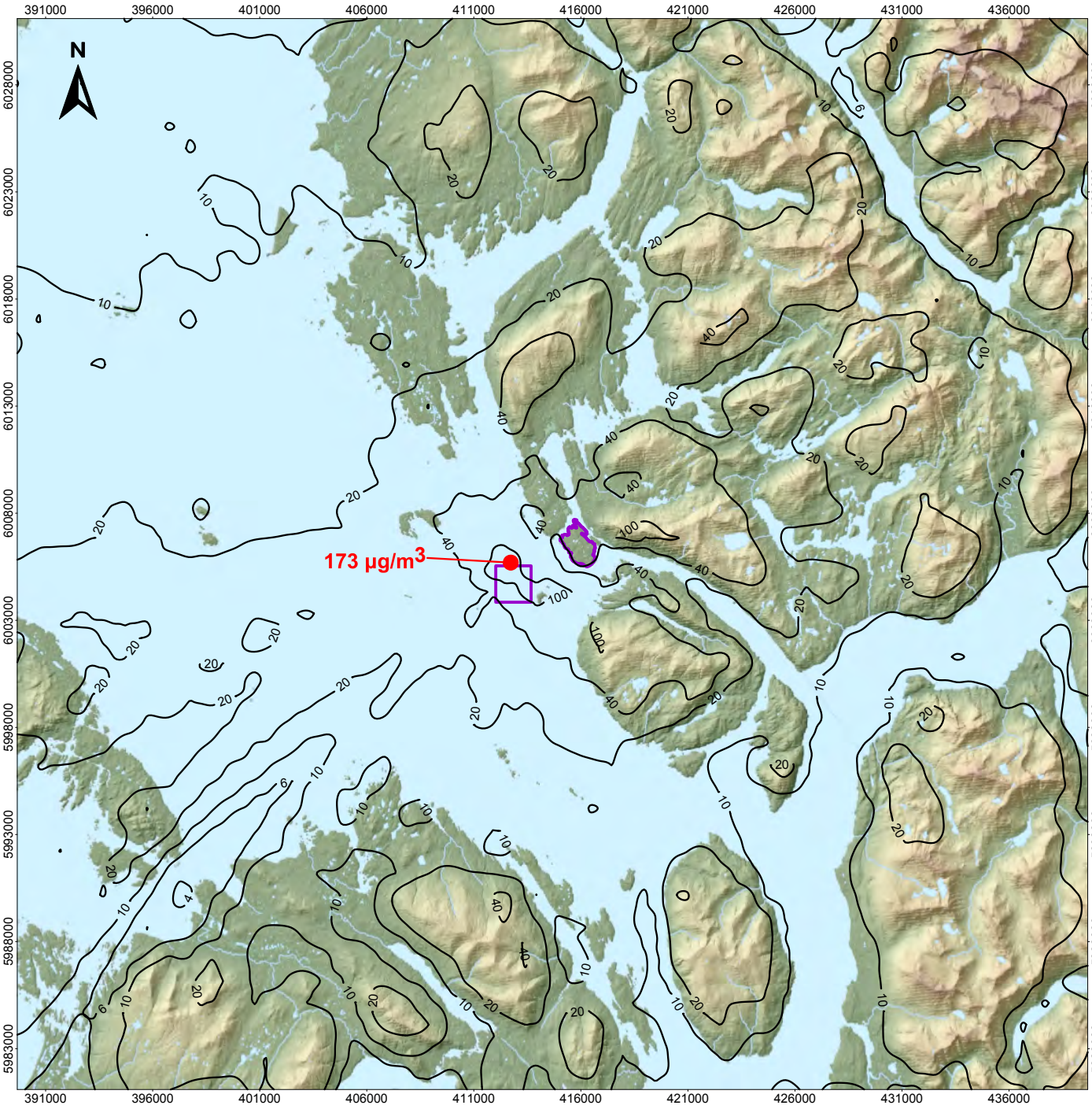
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	pr_SO2_1hr_15m	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-15**

V:\1231\active\EM\1231 10537\disc_folders\air_quality\surfer\Isopleths\Project\pr_SO2_1hr_15m.srf



Maximum Concentration (µg/m³)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted 1-hour Average Ground-level NO_2 Concentrations Associated with the Project-alone Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

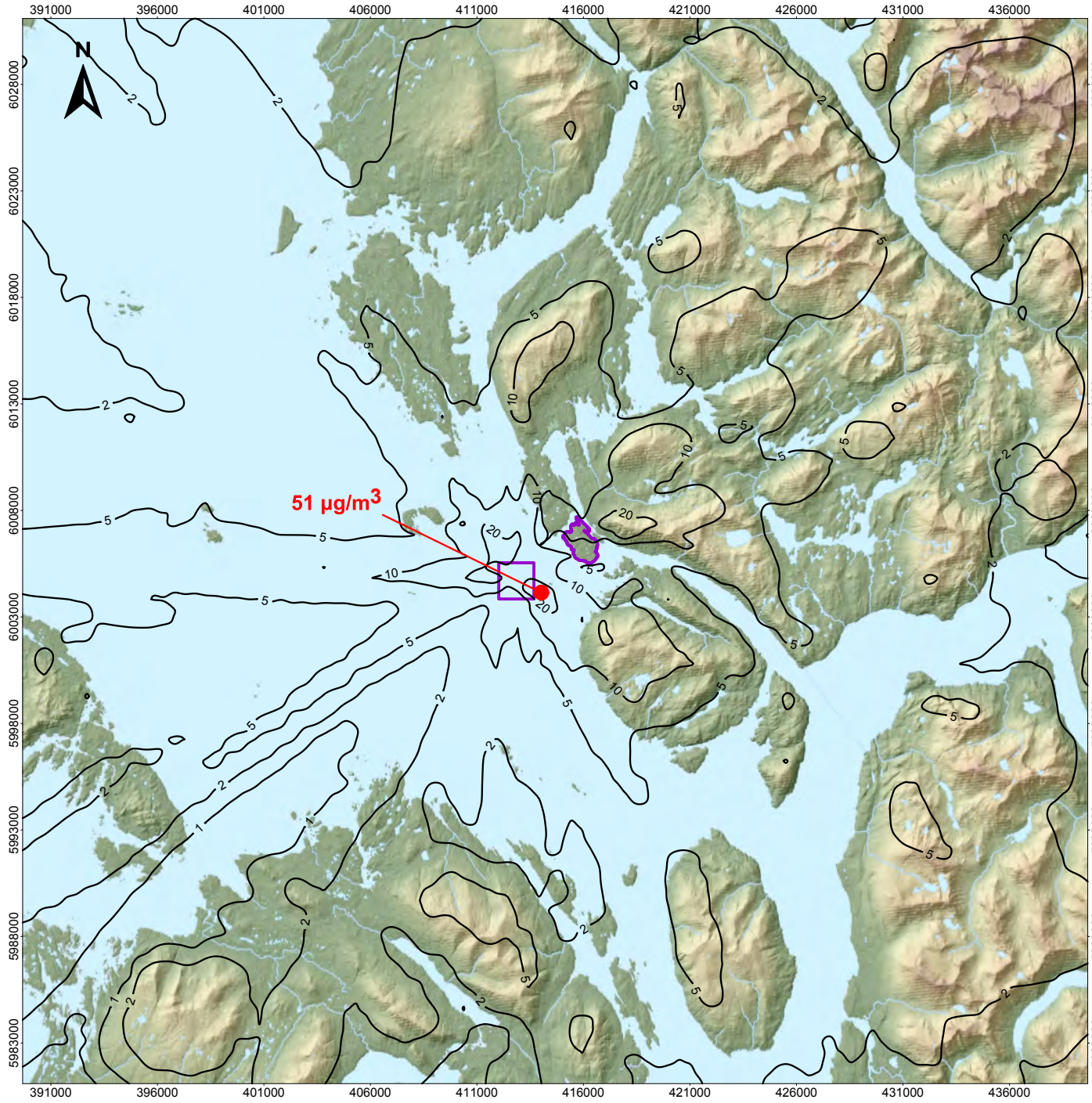
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	pr_NO2_1hr	DATUM:	NAD 83
DRAWN BY:	K. Wells	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-16**

V:\1231\active\EM\123110537\disc_folders\air_quality\surfer\Isopleths\Project\pr_NO2_1hr.srf



Maximum Concentration (µg/m³)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted 24-hour Average Ground-level NO_2 Concentrations Associated with the Project-alone Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

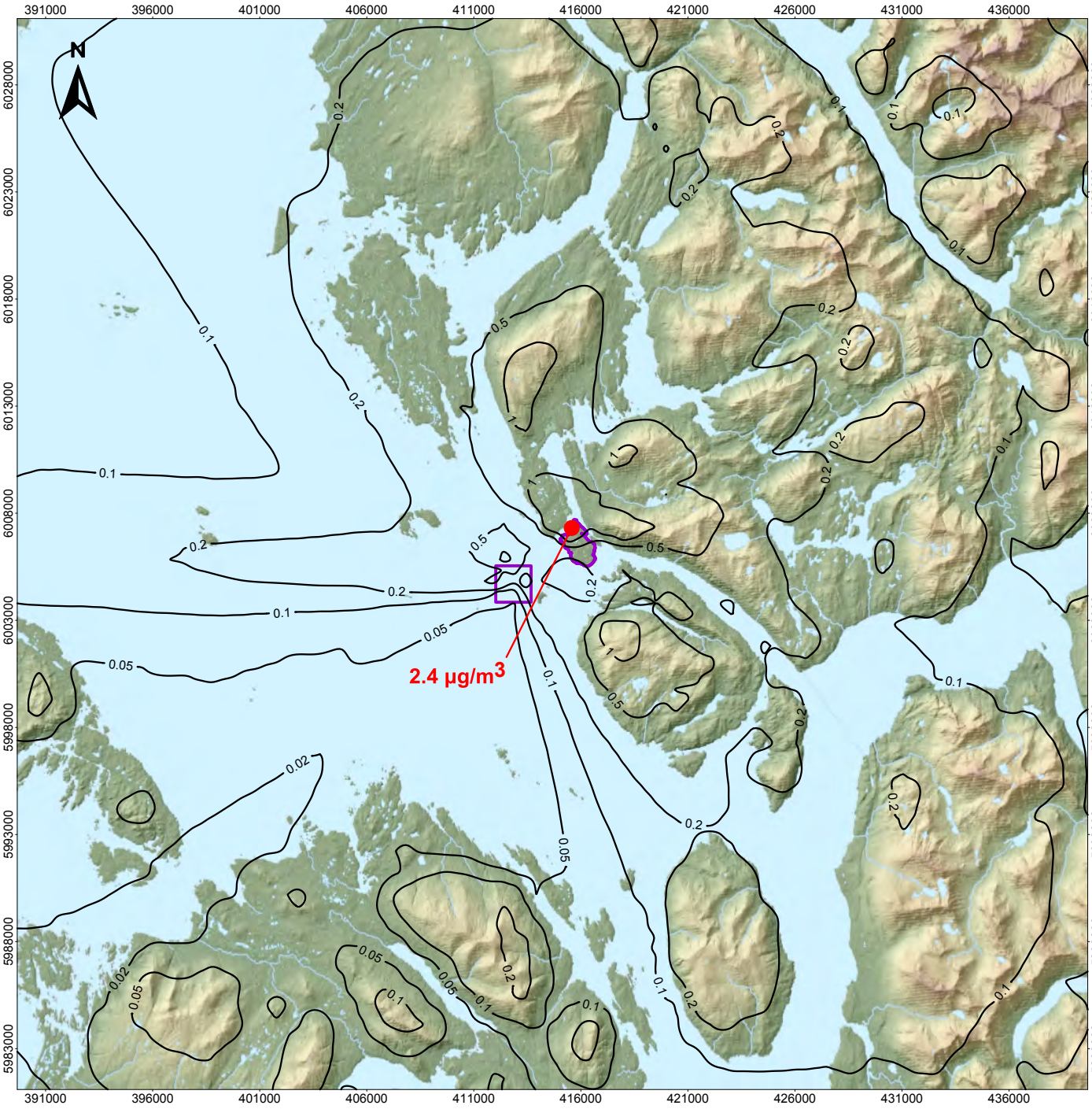
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	pr_NO2_24hr	DATUM:	NAD 83
DRAWN BY:	K. Wells	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-17**

V:\1231\active\EM\1231 10537\disc_folders\air_quality\surfer\Isopleths\Project\pr_NO2_24hr.srf



Units: µg/m³
Annual NO_2 AAQO = 60 µg/m³

Distance (m)
0 3000 6000 9000

Maximum Concentration (µg/m³)
Project Boundary

Pacific NorthWest LNG

Maximum Predicted Annual Average Ground-level NO_2 Concentrations Associated with the Project-alone Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

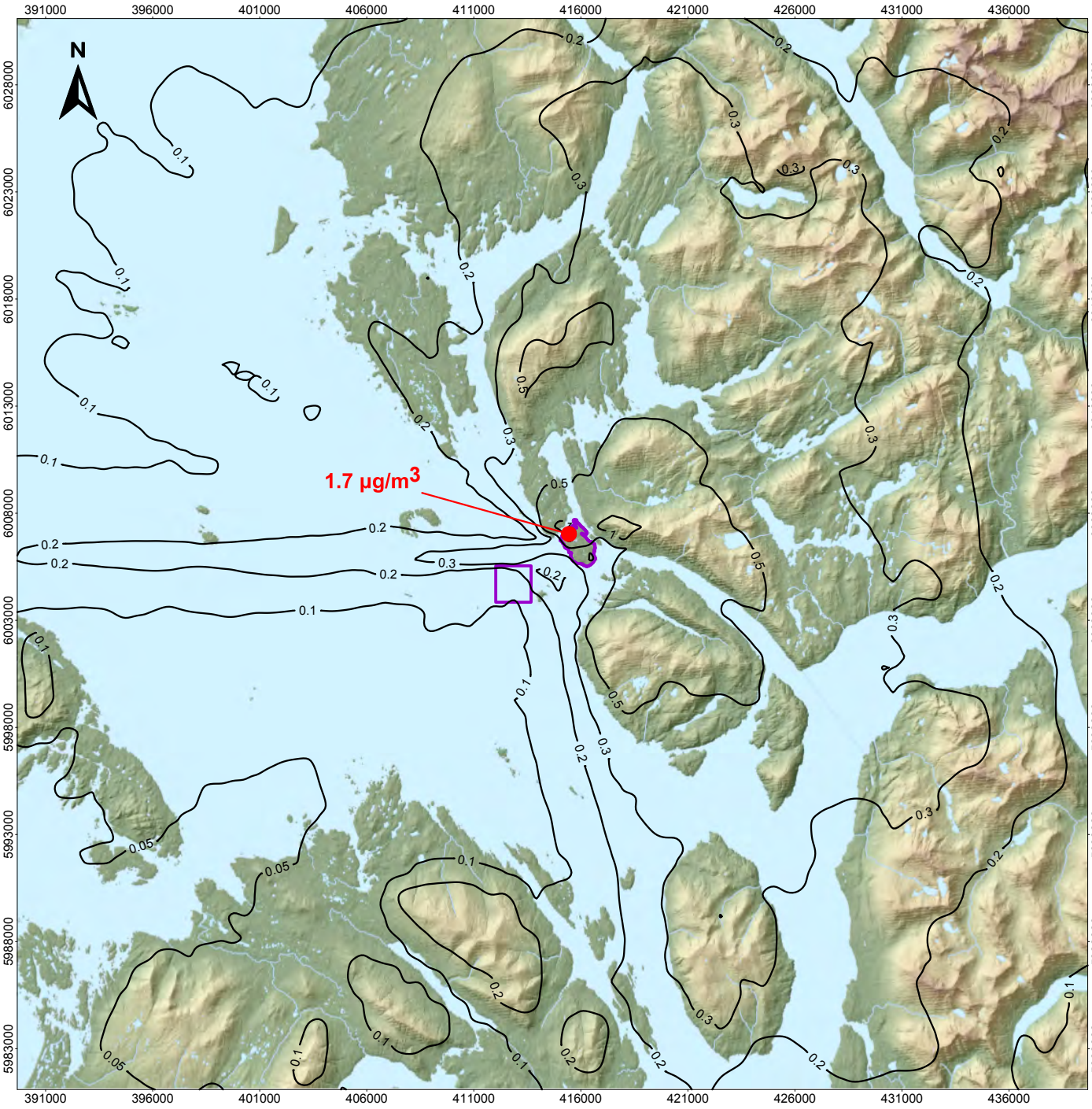
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	pr_NO2_ann	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-18**

V:\1231\active\EM\1231110537\disc_folders\air_quality\surfer\Isopleths\Project\pr_NO2_ann.srf



Maximum Concentration (µg/m³)

Project Boundary

Pacific NorthWest LNG

98th Percentile 24-hour Average
Ground-level $PM_{2.5}$ Concentrations
Associated with the Project-alone Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

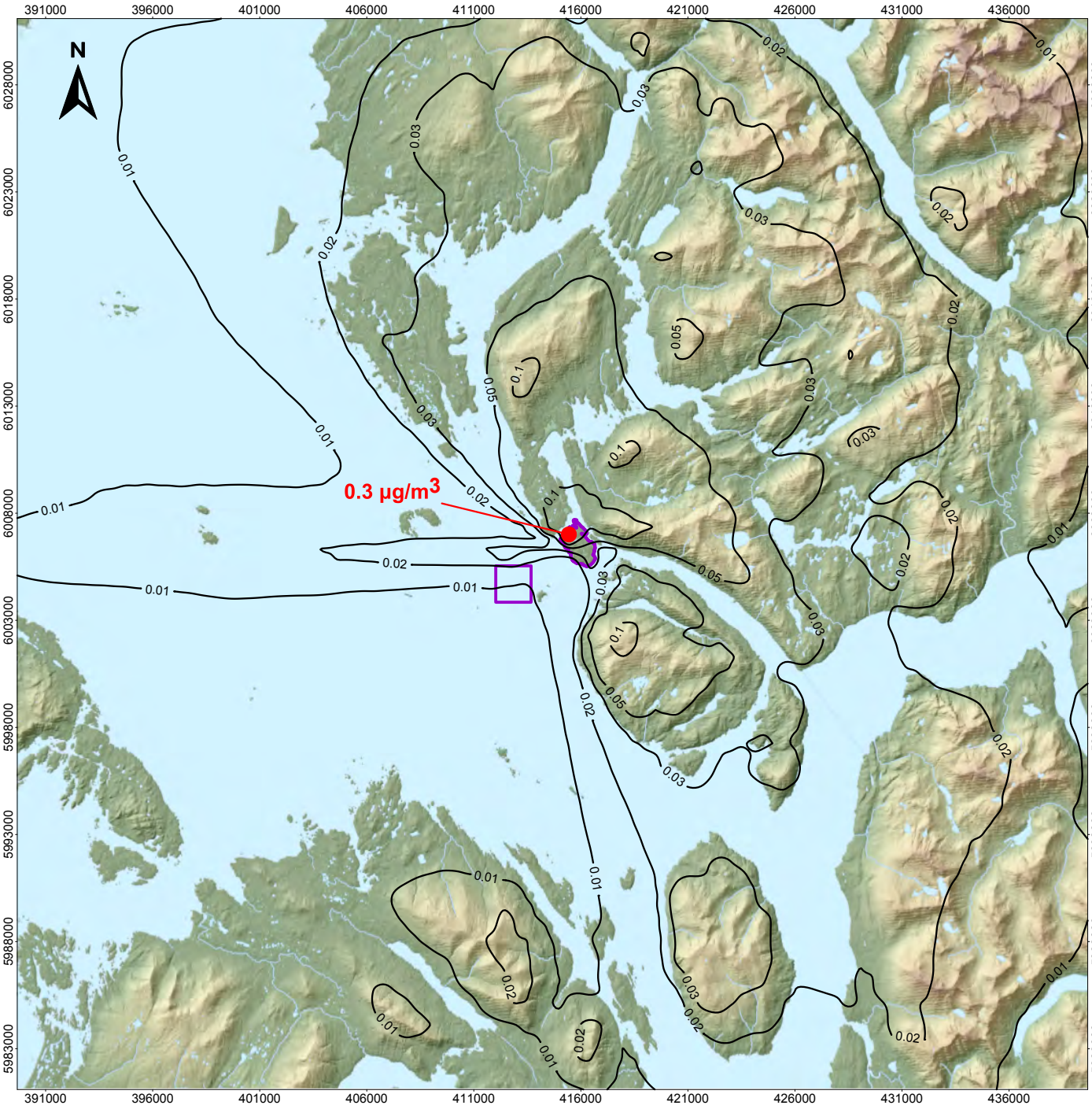
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	pr_PM2.5_24hr	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-19**

V:\1231\active\EM\123110537\disc_folders\air_quality\surfer\Isopleths\Project\pr_PM2.5_24hr.srf



Units: µg/m³
Annual $PM_{2.5}$ AAQO = 8 µg/m³

Maximum Concentration (µg/m³)
Project Boundary

Pacific NorthWest LNG

Maximum Predicted Annual Average Ground-level $PM_{2.5}$ Concentrations Associated with the Project-alone Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

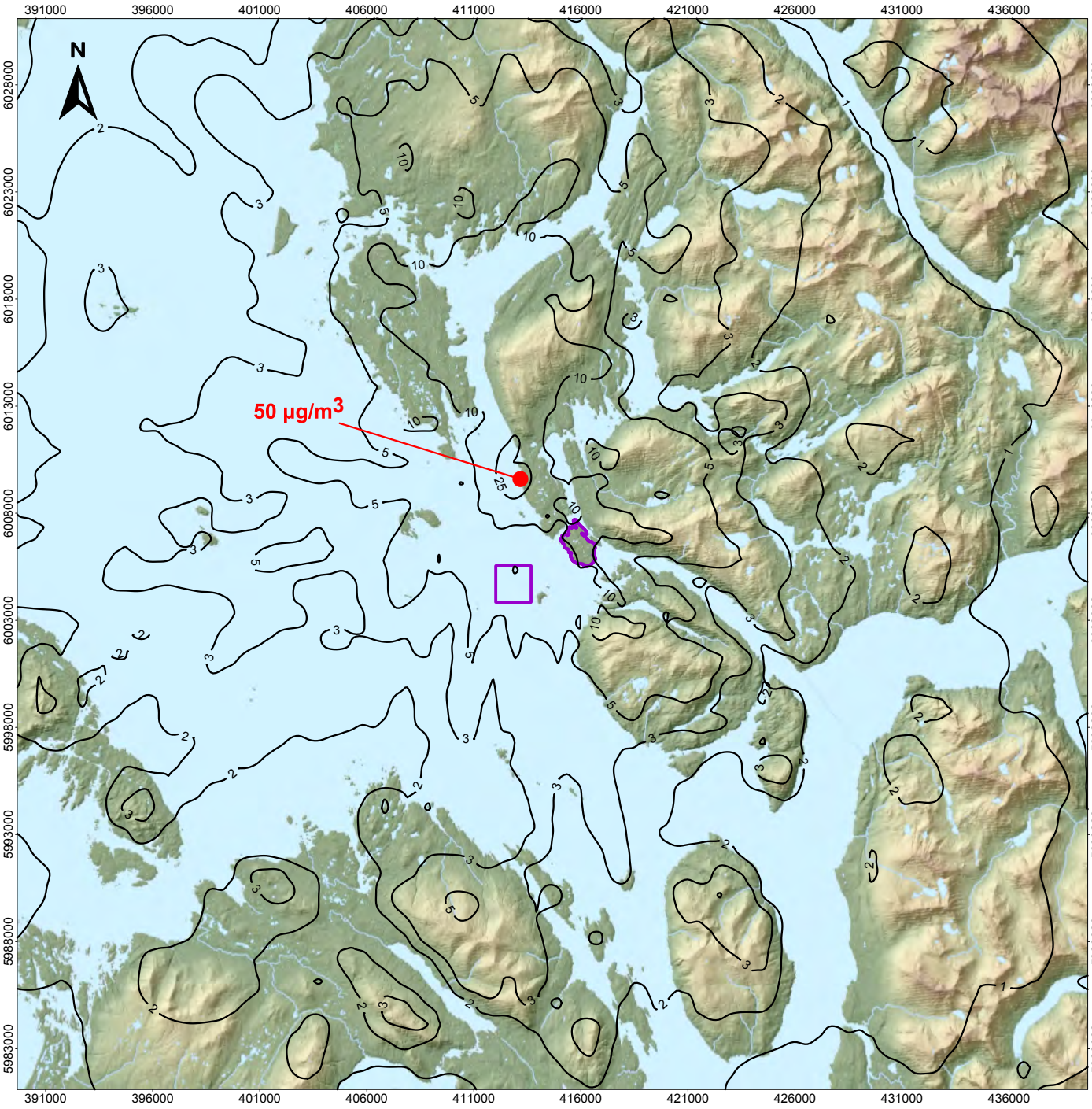
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	pr_PM2.5_ann	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-20**

V:\1231\active\EM\1231 10537\disc_folders\air_quality\surfer\Isopleths\Project\pr_PM2.5_ann.srf



Maximum Concentration (µg/m³)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted 1-hour Average Ground-level SO_2 Concentrations Associated with the Application Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

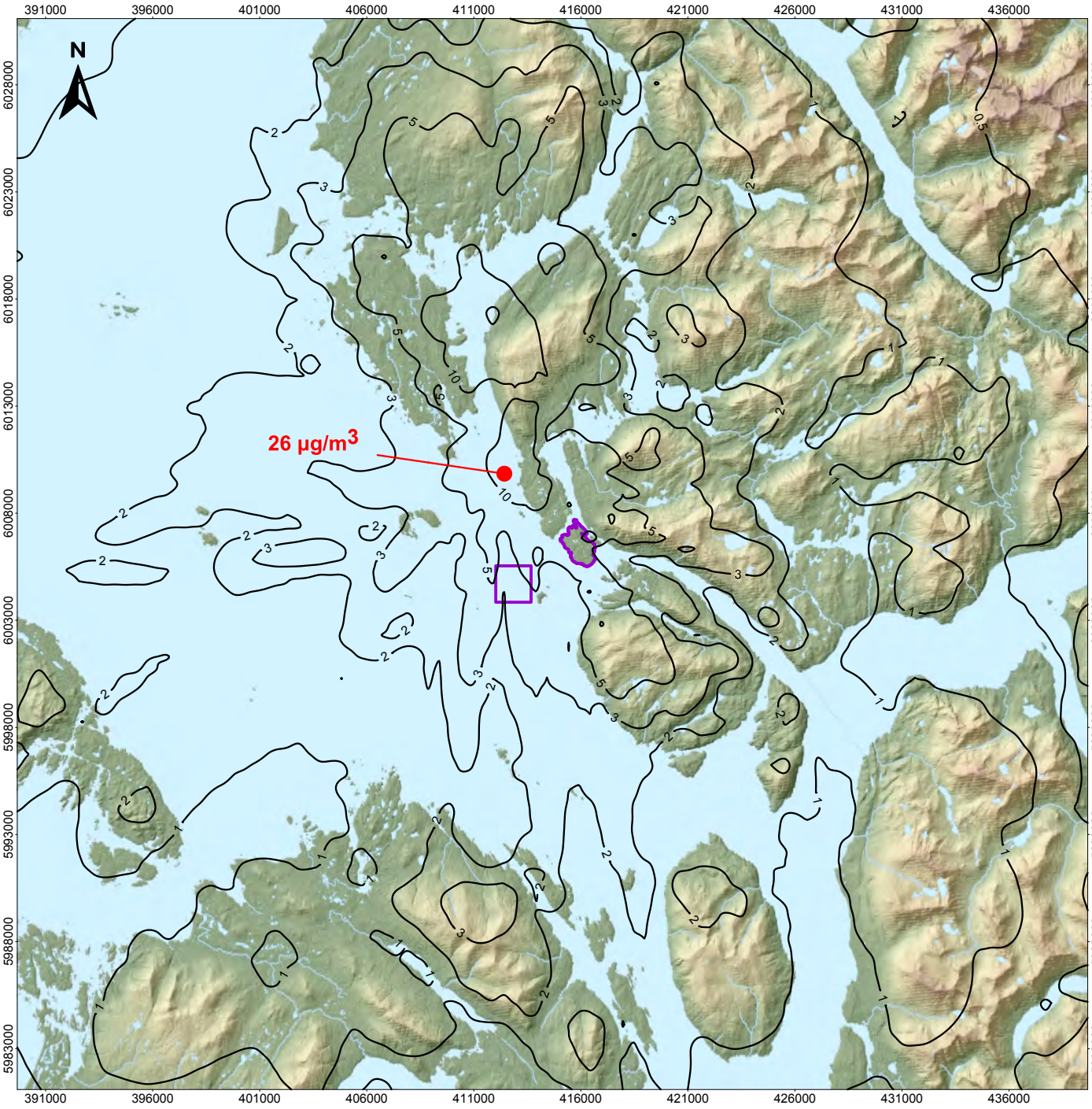
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	ap_SO2_1hr	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-21**

V:\1231\active\EM\1231 10537\disc_folders\air_quality\surfer\Isopleths\Application\ap_SO2_1hr.srf



Maximum Concentration (µg/m³)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted 3-hour Average Ground-level SO_2 Concentrations Associated with the Application Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

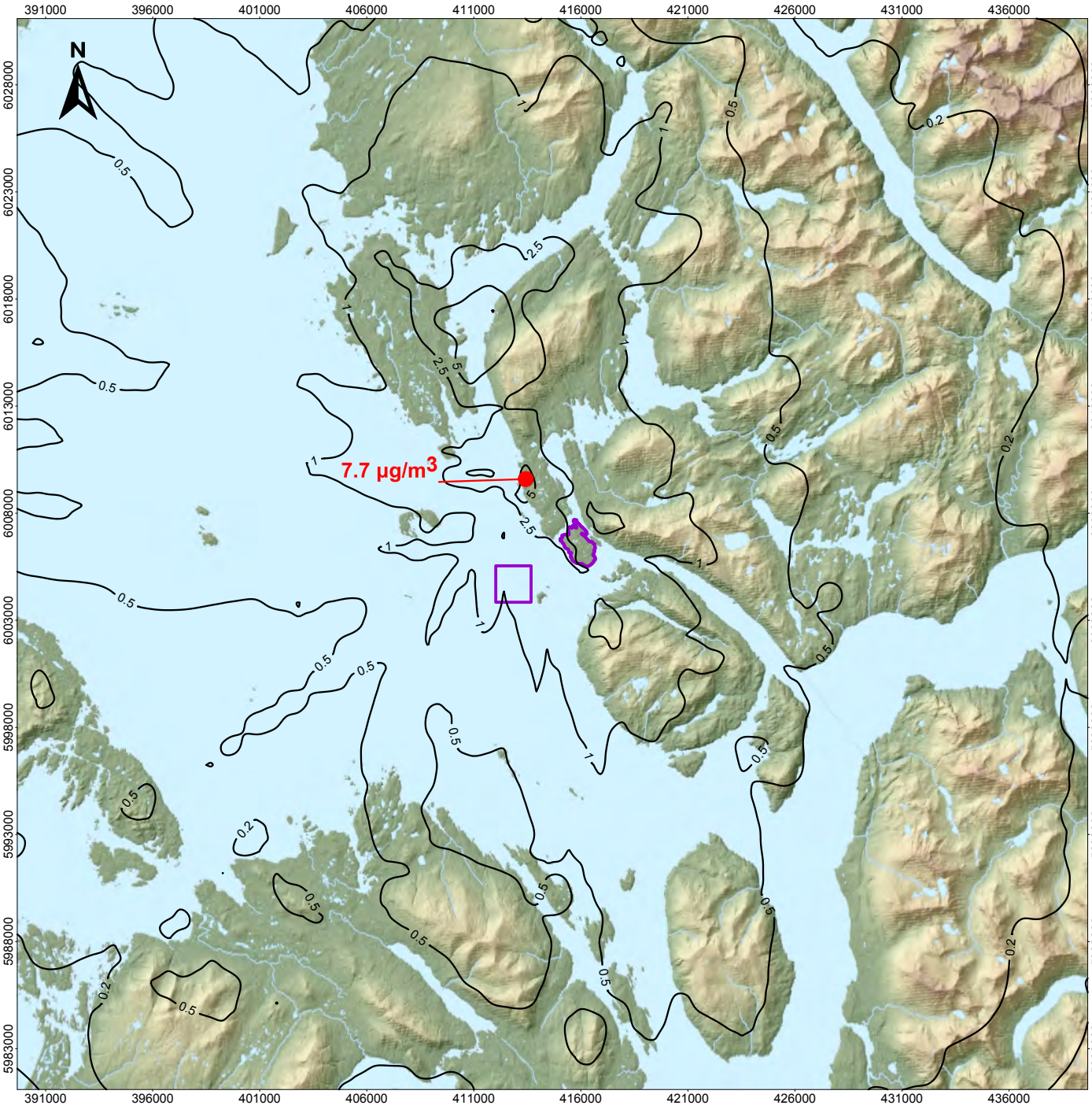
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	ap_SO2_3hr	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-22**

V:\1231\active\EM\123110537\disc_folders\air_quality\surfer\Isopleths\Appliaction\ap_SO2_3hr.srf



Units: µg/m³
24-hr SO_2 AAQO = 150 µg/m³

Maximum Concentration (µg/m³)
Project Boundary

Pacific NorthWest LNG

Maximum Predicted 24-hour Average Ground-level SO_2 Concentrations Associated with the Application Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

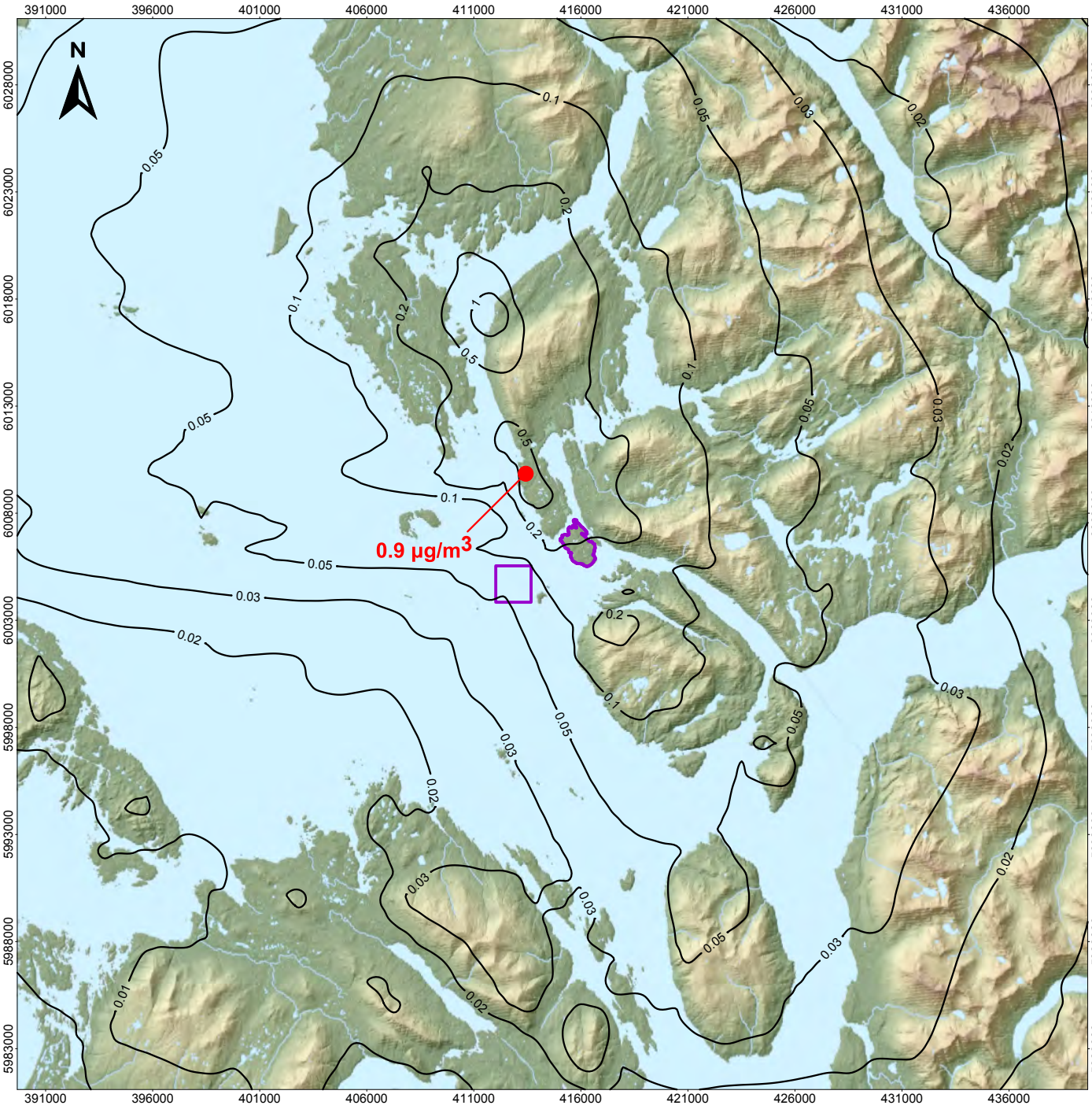
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	ap_SO2_24hr	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-23**

V:\1231\active\EM\1231110537\disc_folders\air_quality\surfer\Isopleths\Application\ap_SO2_24hr.srf



Units: µg/m³
Annual SO_2 AAQO = 25 µg/m³

Maximum Concentration (µg/m³)
Project Boundary

Pacific NorthWest LNG

Maximum Predicted Annual Average Ground-level SO_2 Concentrations Associated with the Application Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

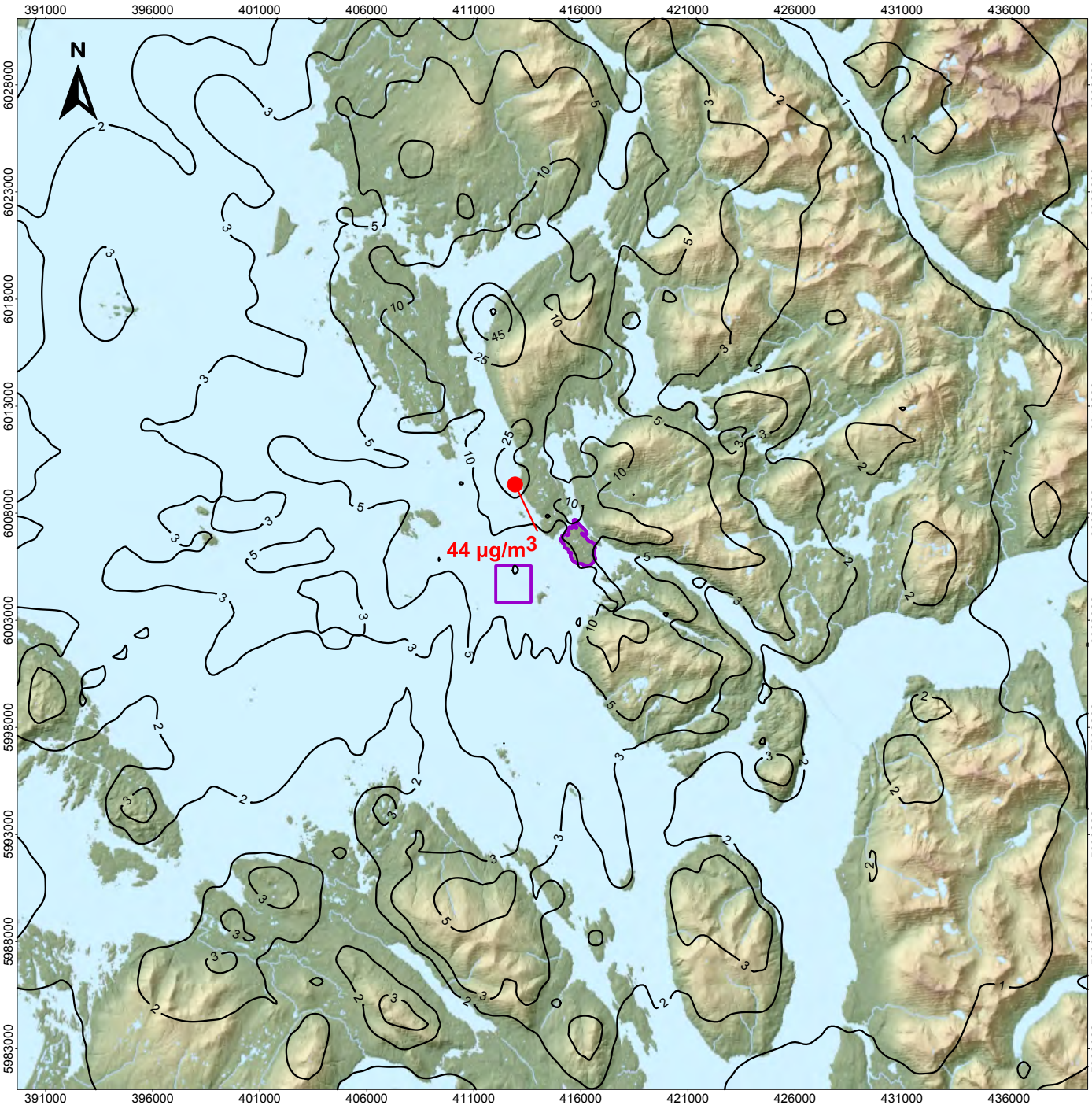
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	ap_SO2_ann	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-24**

V:\1231\active\EM\123110537\disc_folders\air_quality\surfer\Isopleths\Application\ap_SO2_ann.srf



Maximum Concentration (µg/m³)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted 1-hour Average
15-metre SO_2 Concentrations
Associated with the Application Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

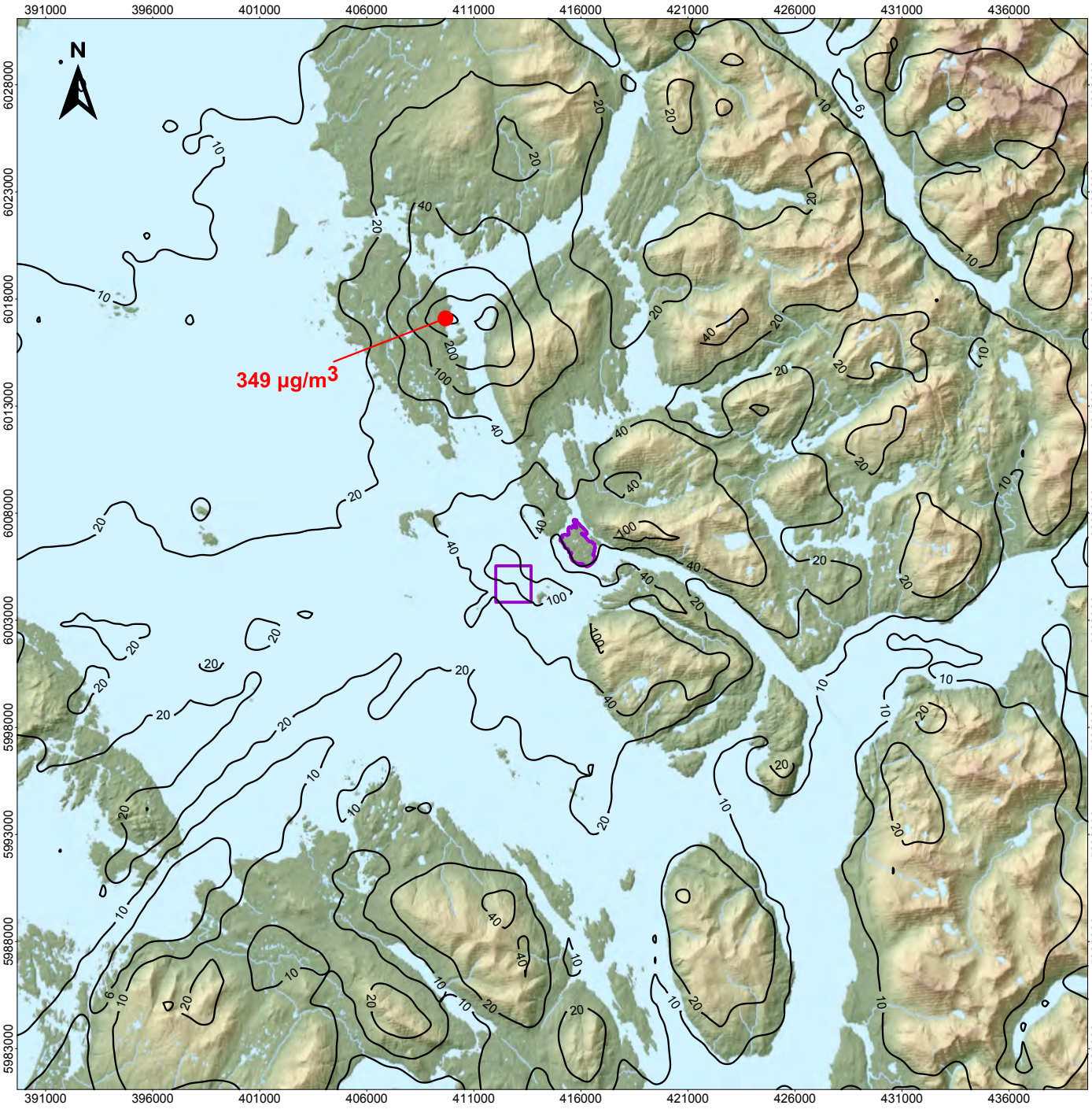
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	ap_SO2_1hr_15m	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-25**

V:\1231\active\EM\1231110537\disc_folders\air_quality\surfer\Isopleths\Application\ap_SO2_1hr_15m.srf



Maximum Concentration (µg/m³)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted 1-hour Average Ground-level NO_2 Concentrations Associated with the Application Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

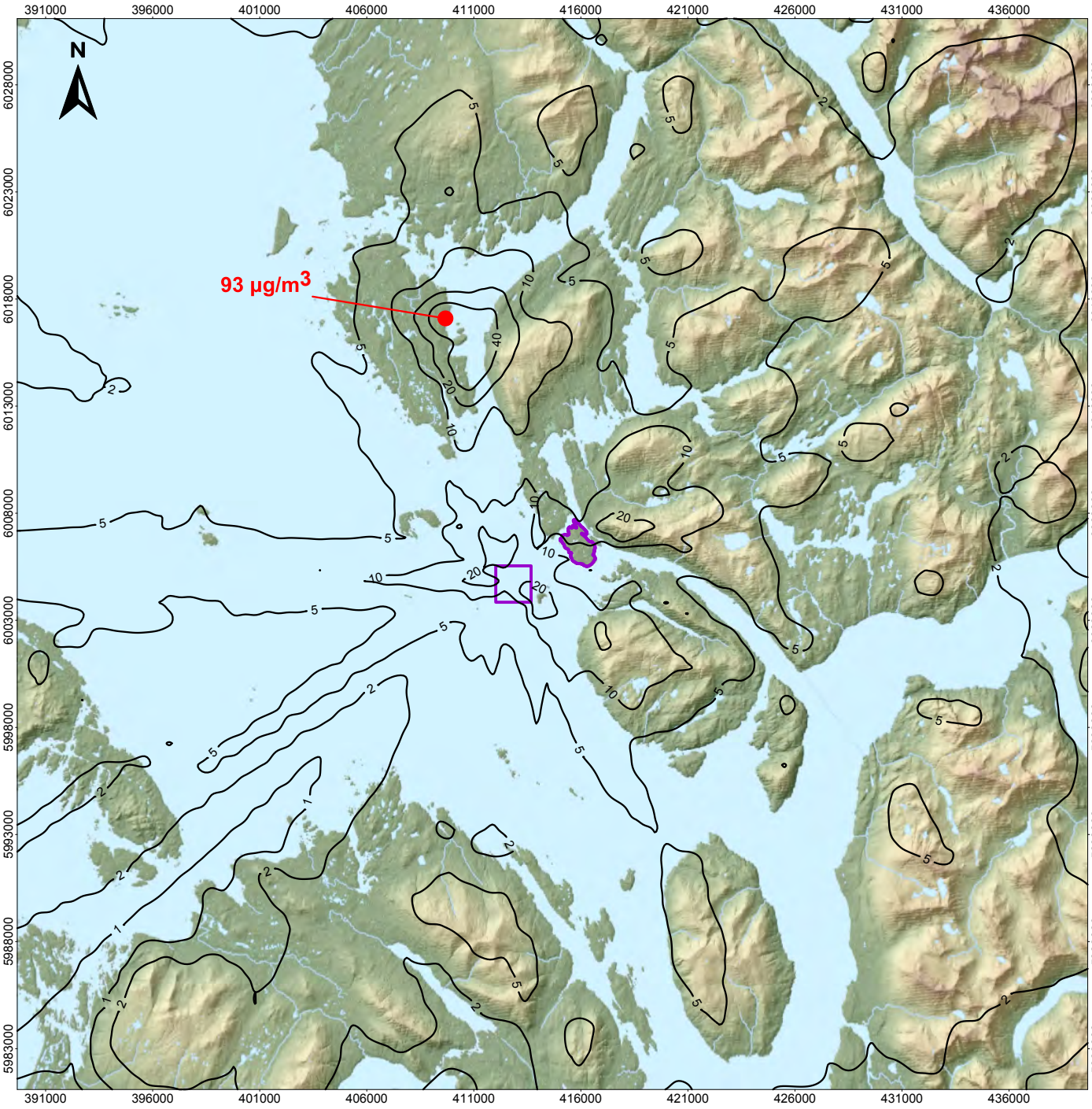
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	ap_NO2_1hr	DATUM:	NAD 83
DRAWN BY:	K. Wells	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-26**

V:\1231\active\EM\123110537\disc_folders\air_quality\surfer\Isopleths\Application\ap_NO2_1hr.srf



Maximum Concentration (µg/m³)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted 24-hour Average Ground-level NO_2 Concentrations Associated with the Application Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

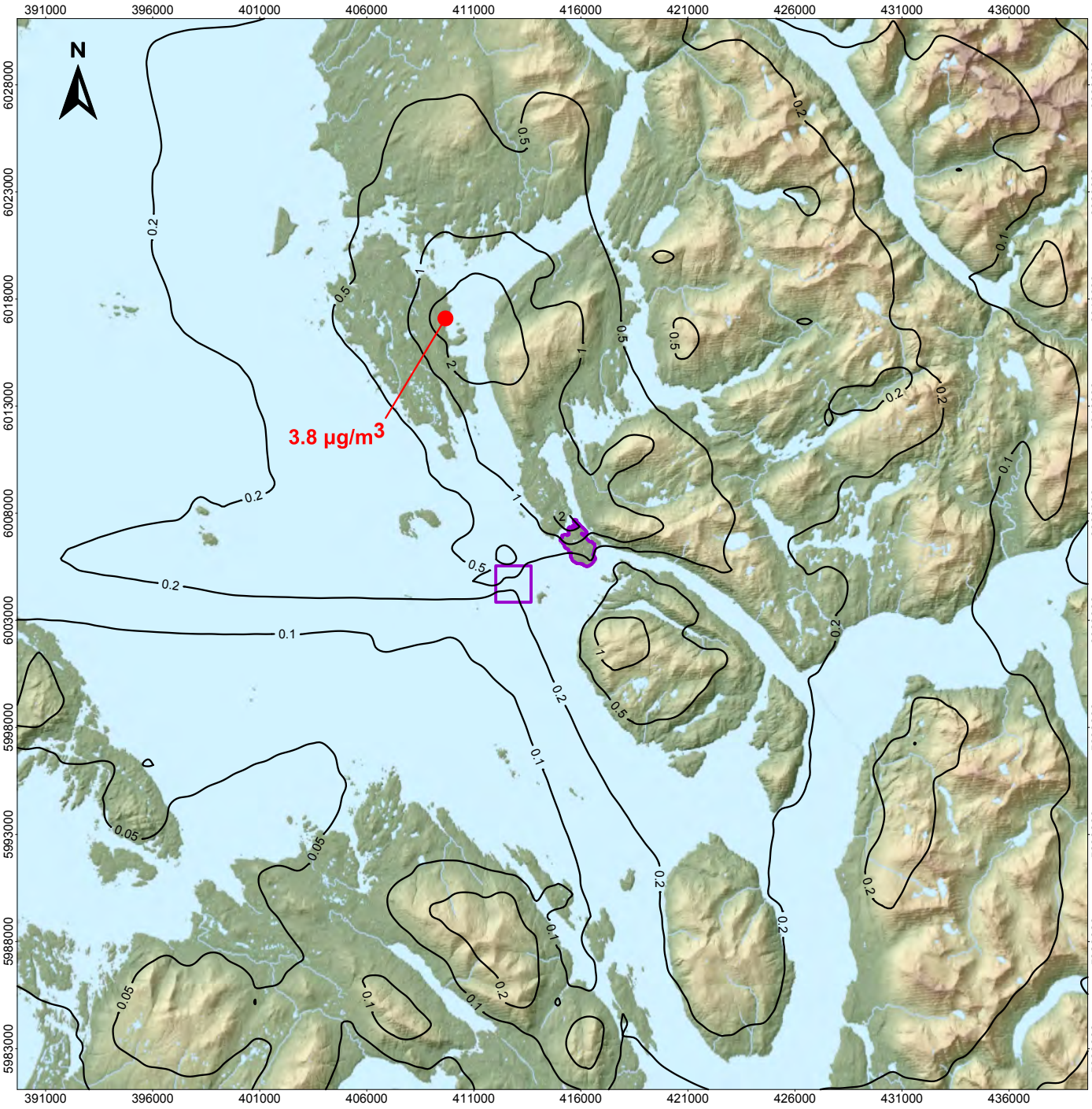
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	ap_NO2_24hr	DATUM:	NAD 83
DRAWN BY:	K. Wells	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-27**

V:\1231\active\EM\123110537\disc_folders\air_quality\surfer\Isopleths\Application\ap_NO2_24hr.srf



Units: µg/m³
Annual NO_2 AAQO = 60 µg/m³

Maximum Concentration (µg/m³)
Project Boundary

Pacific NorthWest LNG

Maximum Predicted Annual Average Ground-level NO_2 Concentrations Associated with the Application Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

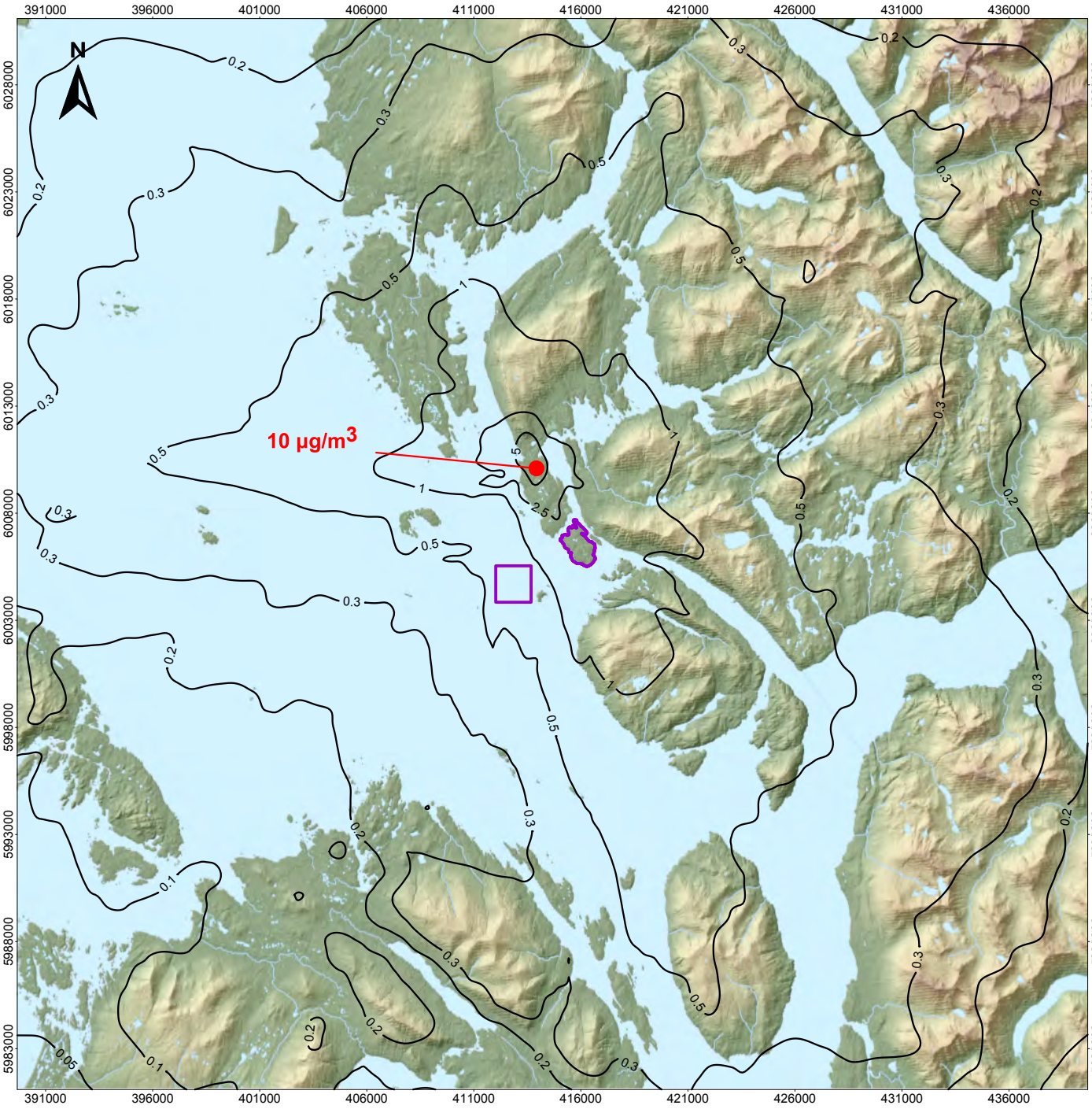
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	ap_NO2_ann	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-28**

V:\1231\active\EM\1231110537\disc_folders\air_quality\surfer\Isopleths\Application\ap_NO2_ann.srf



Units: µg/m³
24-hr $PM_{2.5}$ AAQO = 25 µg/m³

- Maximum Concentration (µg/m³)
- Project Boundary

Pacific NorthWest LNG

98th Percentile 24-hour Average Ground-level $PM_{2.5}$ Concentrations Associated with the Application Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

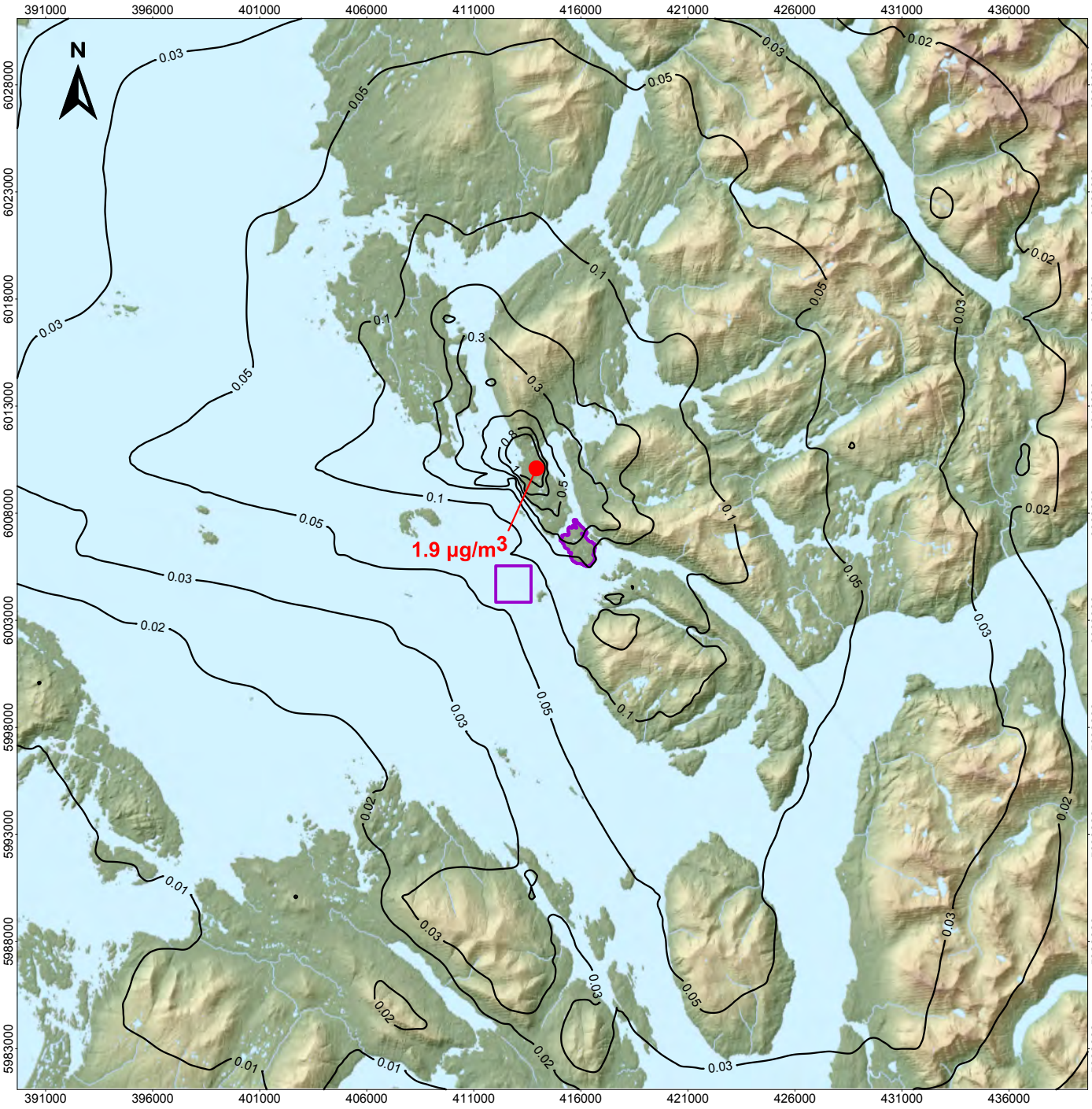
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	ap_PM2.5_24hr	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-29**

V:\1231\active\EM\12311053\7\disc_folders\air_quality\surfer\Isopleths\Application\ap_PM2.5_24hr.srf



Units: µg/m³
Annual $PM_{2.5}$ AAQO = 8 µg/m³

Maximum Concentration (µg/m³)
Project Boundary

Pacific NorthWest LNG

Maximum Predicted Annual Average Ground-level $PM_{2.5}$ Concentrations Associated with the Application Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

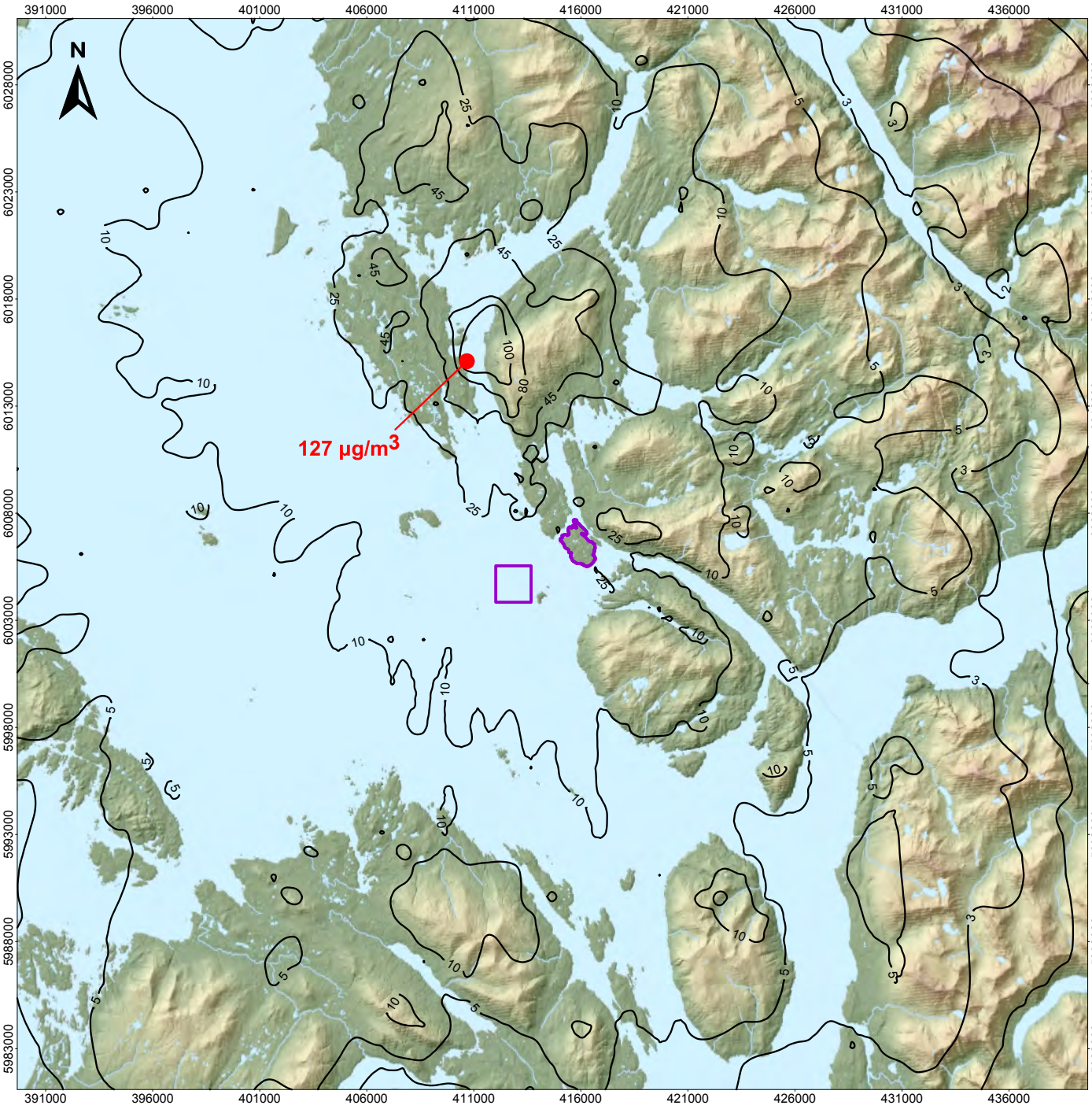
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	ap_PM2.5_ann	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-30**

V:\1231\active\EM\123110537\disc_folders\air_quality\surfer\Isopleths\Application\ap_PM2.5_ann.srf



Maximum Concentration (µg/m³)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted 1-hour Average Ground-level SO_2 Concentrations Associated with the CEA Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

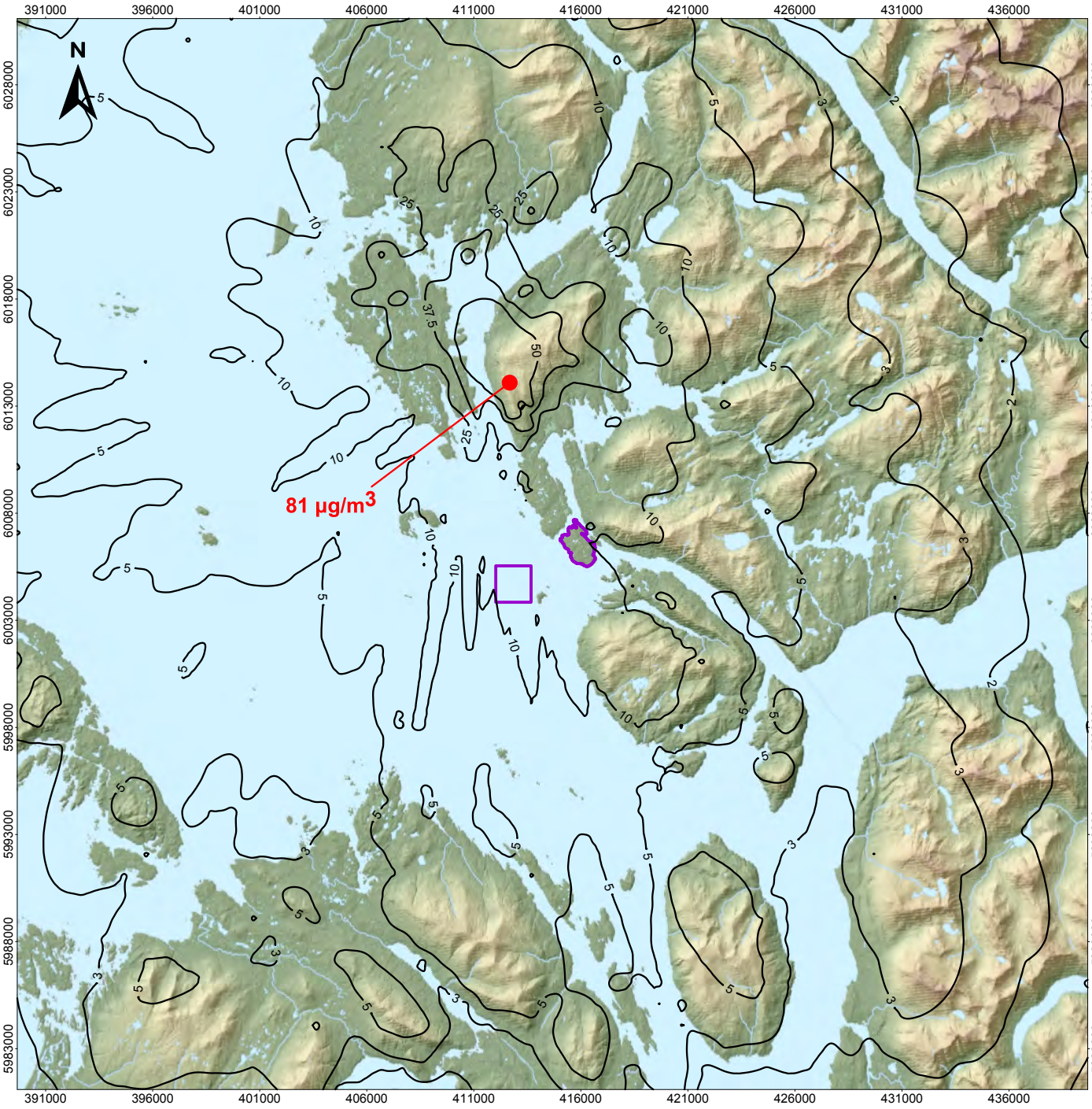
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	cu_SO2_1hr	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-31**

V:\1231\active\EM\123110537\disc_folders\air_quality\surfer\Isopleths\Cumulative\cu_SO2_1hr.srf



Maximum Concentration (µg/m³)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted 3-hour Average Ground-level SO_2 Concentrations Associated with the CEA Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

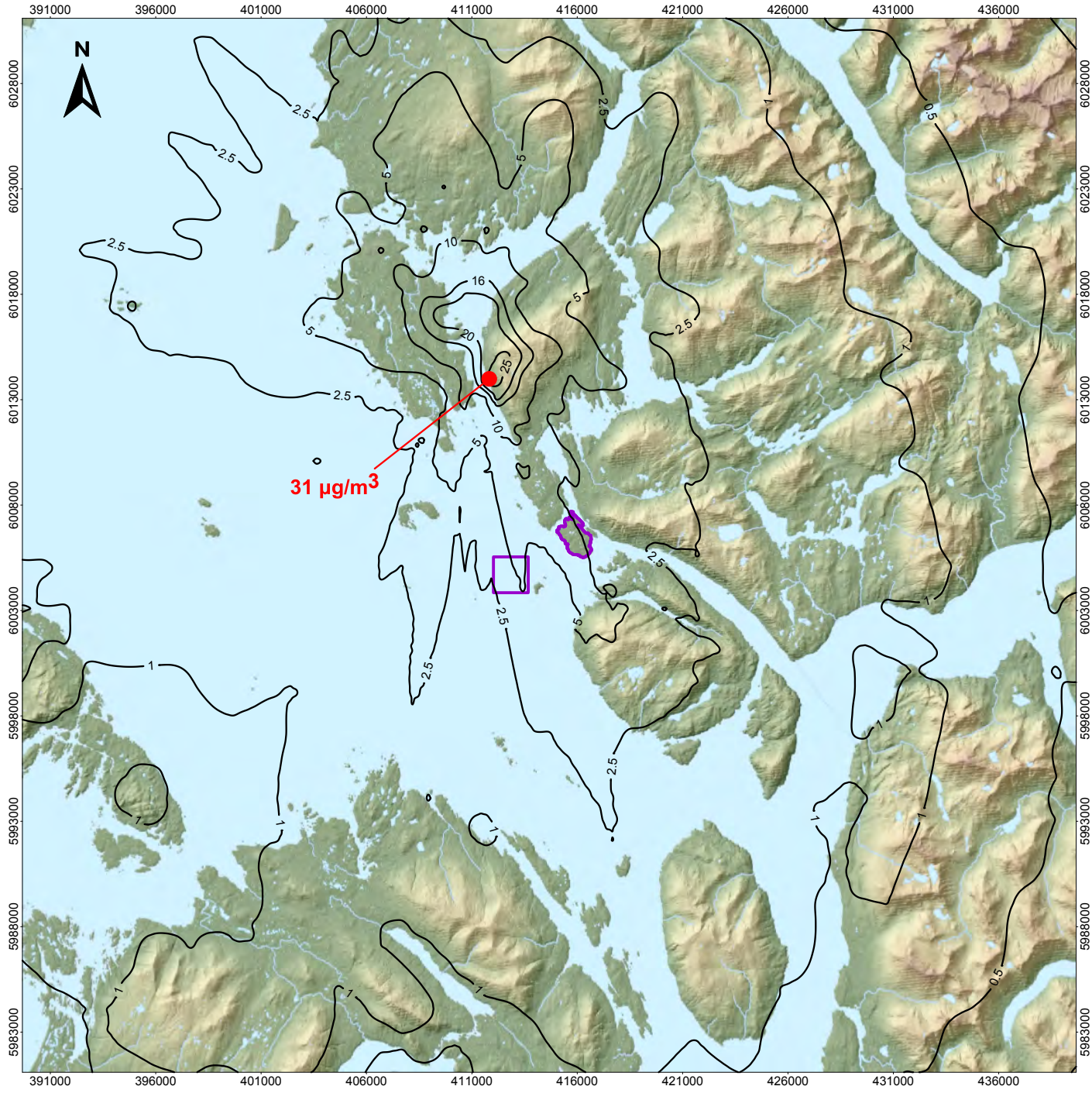
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	cu_SO2_3hr	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-32**

V:\1231\active\EM\1231 10537\disc_folders\air_quality\surfer\Isopleths\Cumulative\cu_SO2_3hr.srf



Maximum Concentration (µg/m³)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted 24-hour Average Ground-level SO_2 Concentrations Associated with the CEA Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

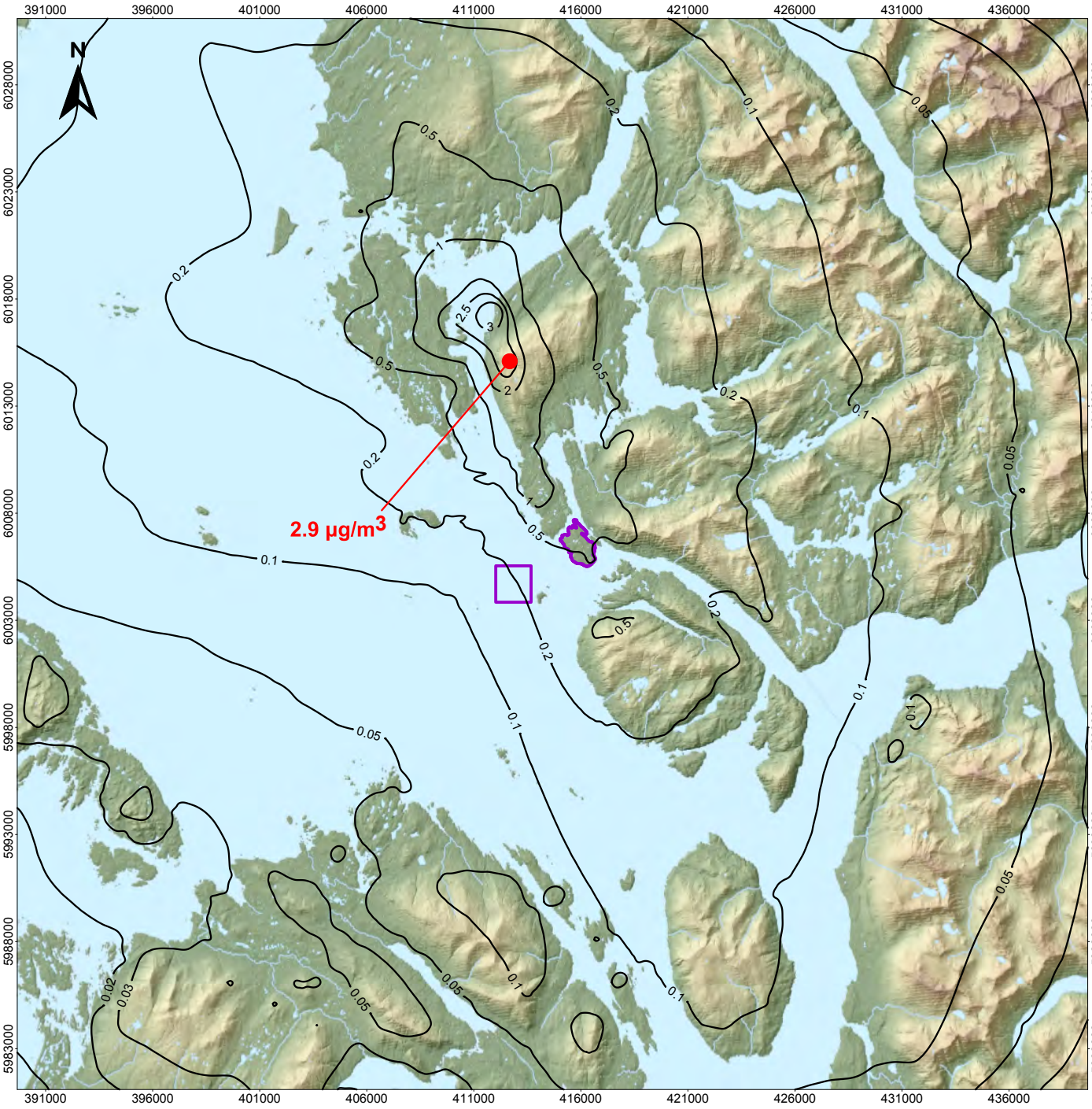
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	cu_SO2_24hr	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-33**

V:\1231\active\EM\123110537\disc_folders\air_quality\surfer\Isopleths\Cumulative\cu_SO2_24hr.srf



Units: µg/m³
Annual SO_2 AAQO = 25 µg/m³

Maximum Concentration (µg/m³)
Project Boundary

Pacific NorthWest LNG

Maximum Predicted Annual Average Ground-level SO_2 Concentrations Associated with the CEA Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

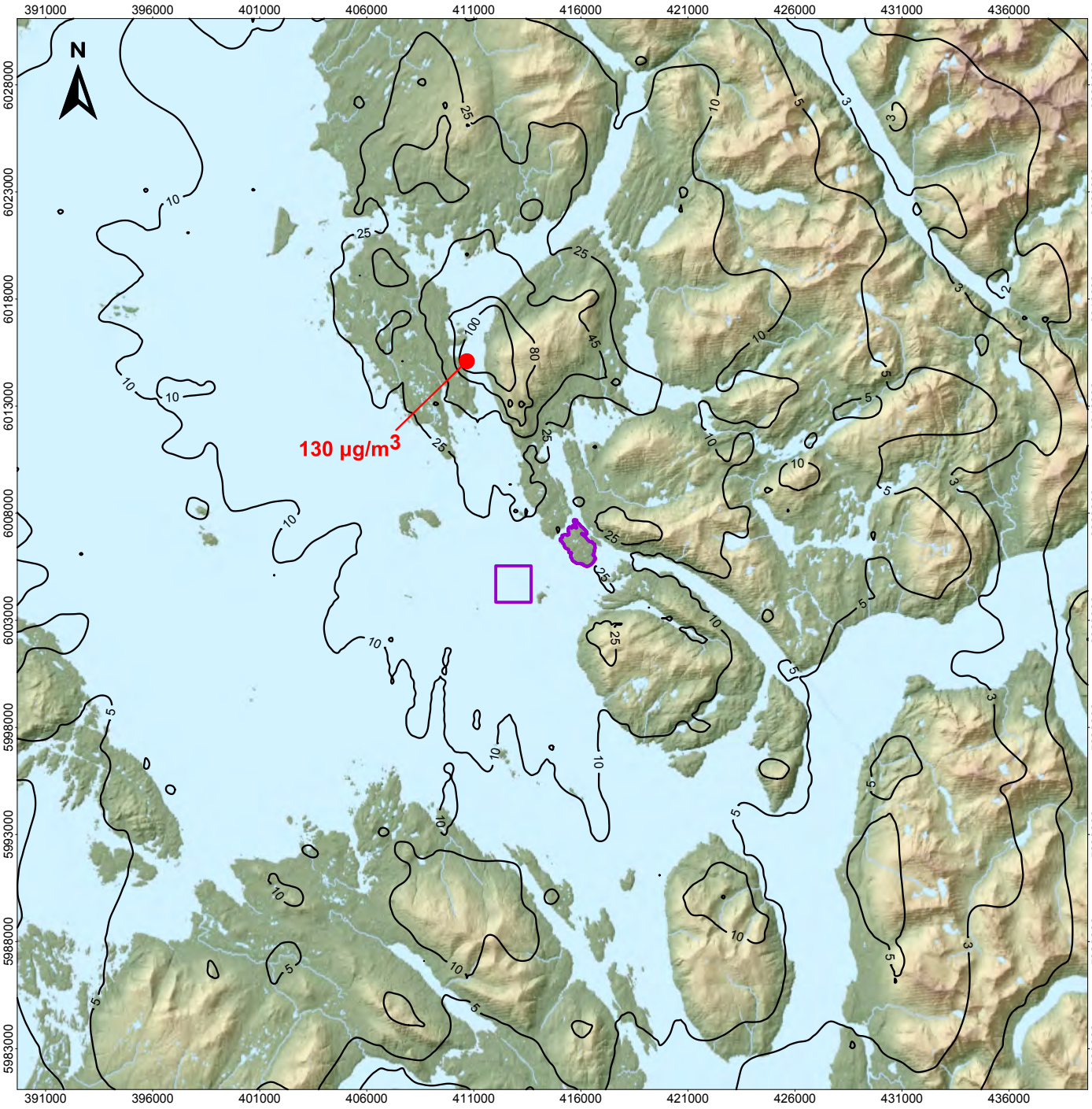
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	cu_SO2_ann	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-34**

V:\1231\active\EM\123110537\disc_folders\air_quality\surfer\Isopleths\Cumulative\cu_SO2_ann.srf



Maximum Concentration (µg/m³)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted 1-hour Average
15-metre SO_2 Concentrations
Associated with the CEA Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

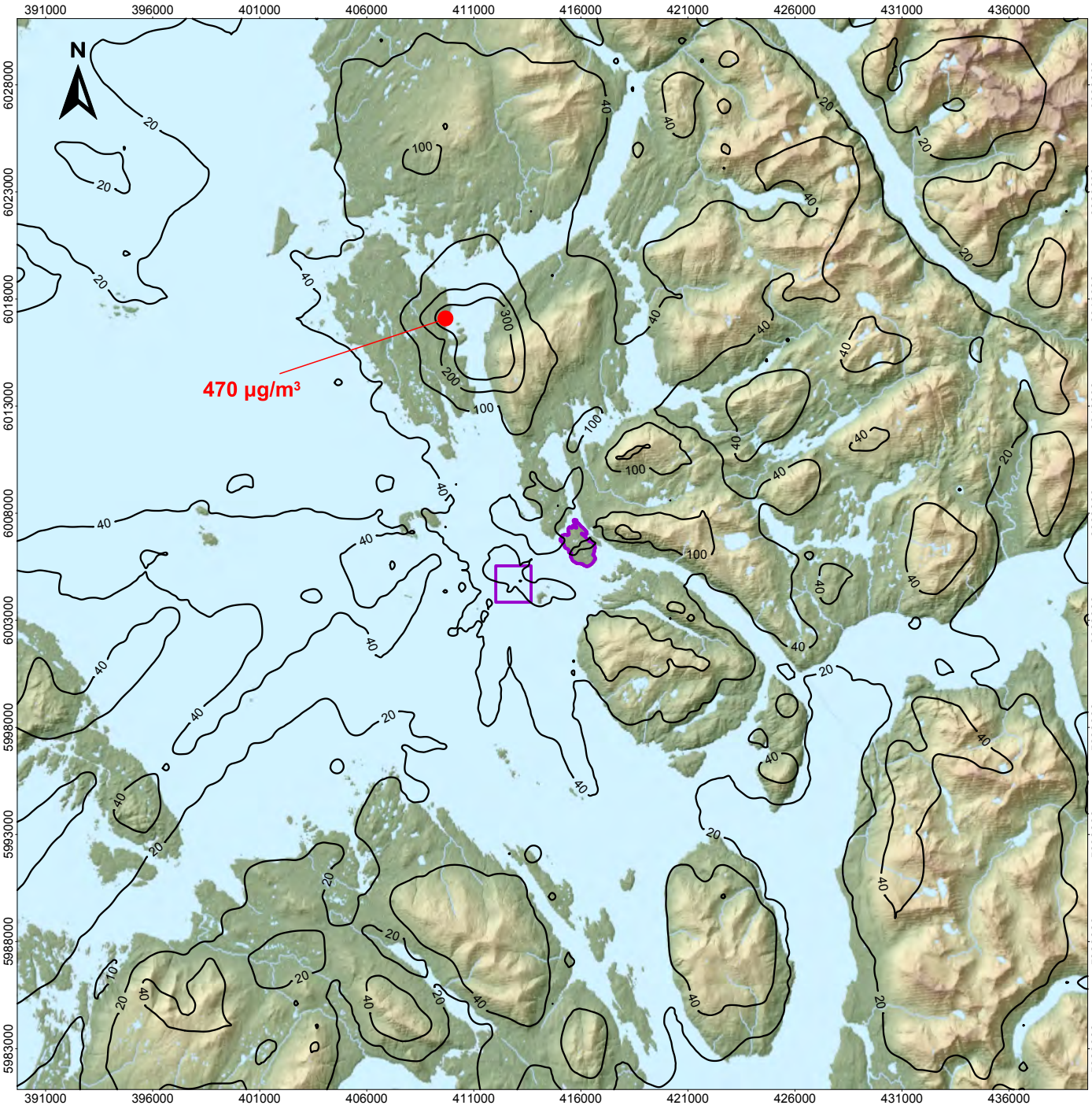
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	cu_SO2_1hr_15m	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-35**

V:\1231\active\EM\123110537\disc_folders\air_quality\surfer\Isopleths\Cumulative\cu_SO2_1hr_15m.srf



Maximum Concentration (µg/m³)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted 1-hour Average Ground-level NO_2 Concentrations Associated with the CEA Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

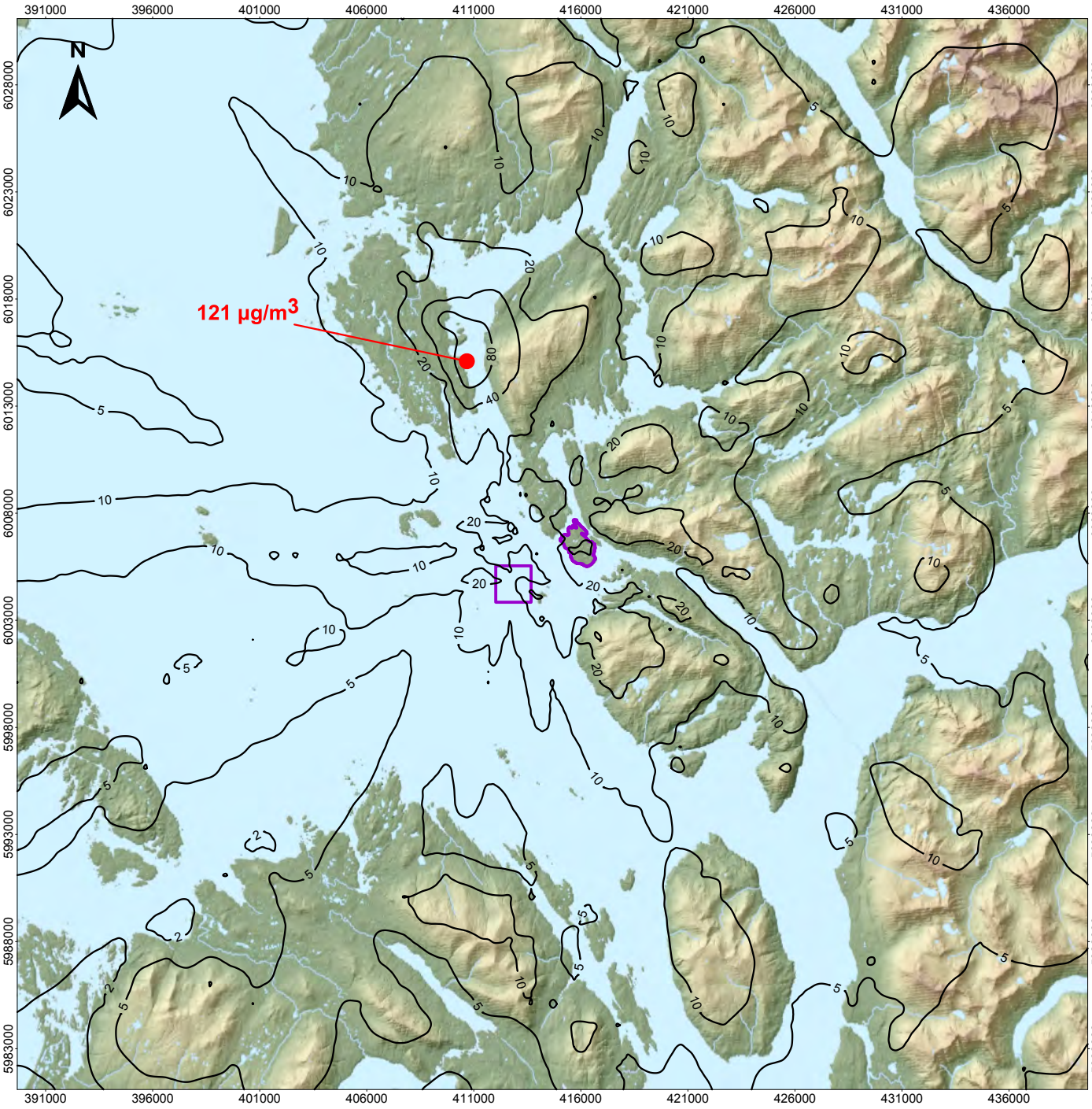
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	cu_NO2_1hr	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-36**

V:\1231\active\EM\123110537\disc_folders\air_quality\surfer\Isopleths\Cumulative\cu_NO2_1hr.srf



Maximum Concentration (µg/m³)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted 24-hour Average Ground-level NO_2 Concentrations Associated with the CEA Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

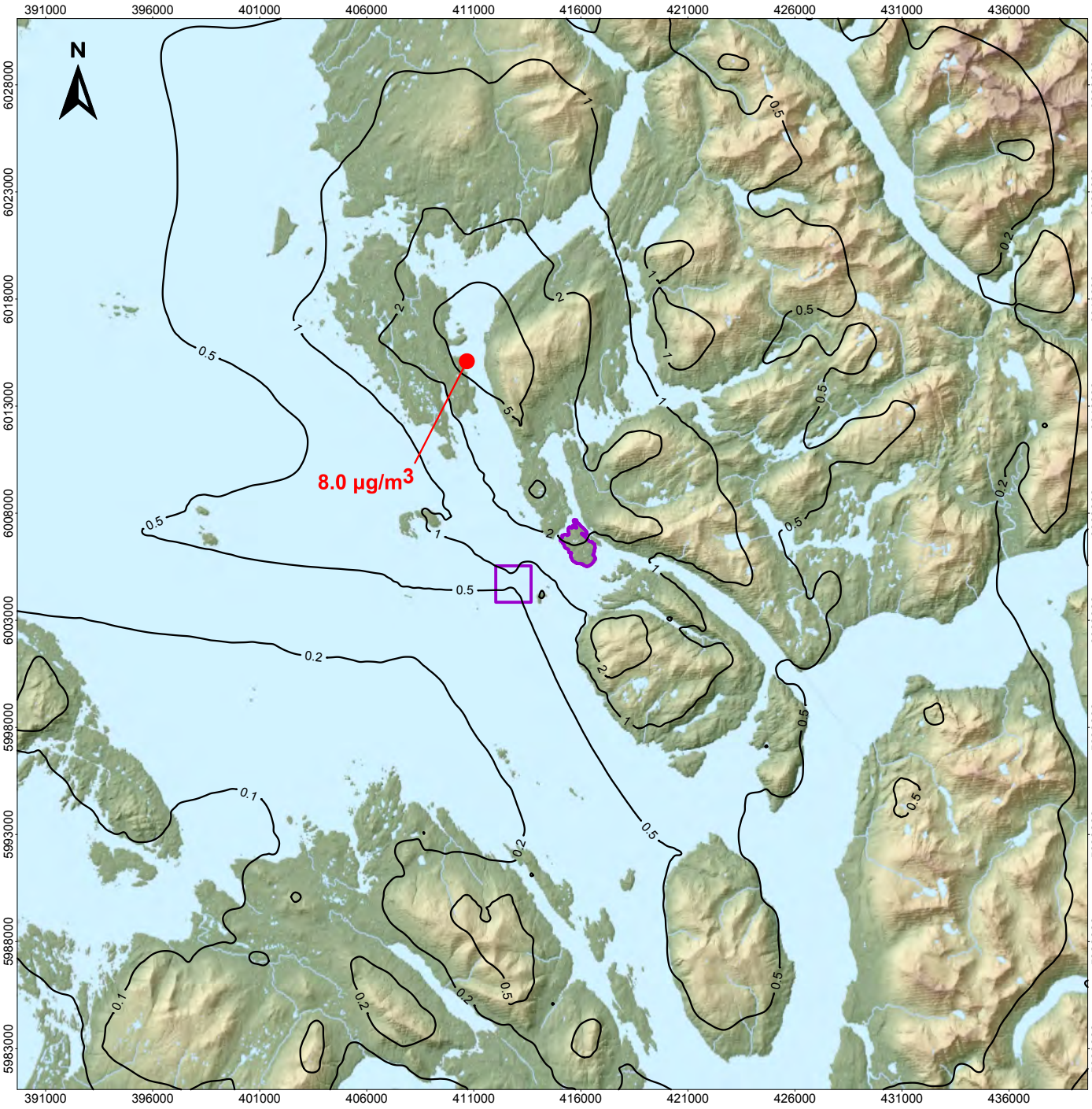
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	cu_NO2_24hr	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-37**

V:\1231\active\EM\1231110537\disc_folders\air_quality\surfer\Isopleths\Cumulative\cu_NO2_24hr.srf



Units: µg/m³
Annual NO_2 AAQO = 60 µg/m³

Maximum Concentration (µg/m³)
Project Boundary

Pacific NorthWest LNG

Maximum Predicted Annual Average Ground-level NO_2 Concentrations Associated with the CEA Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

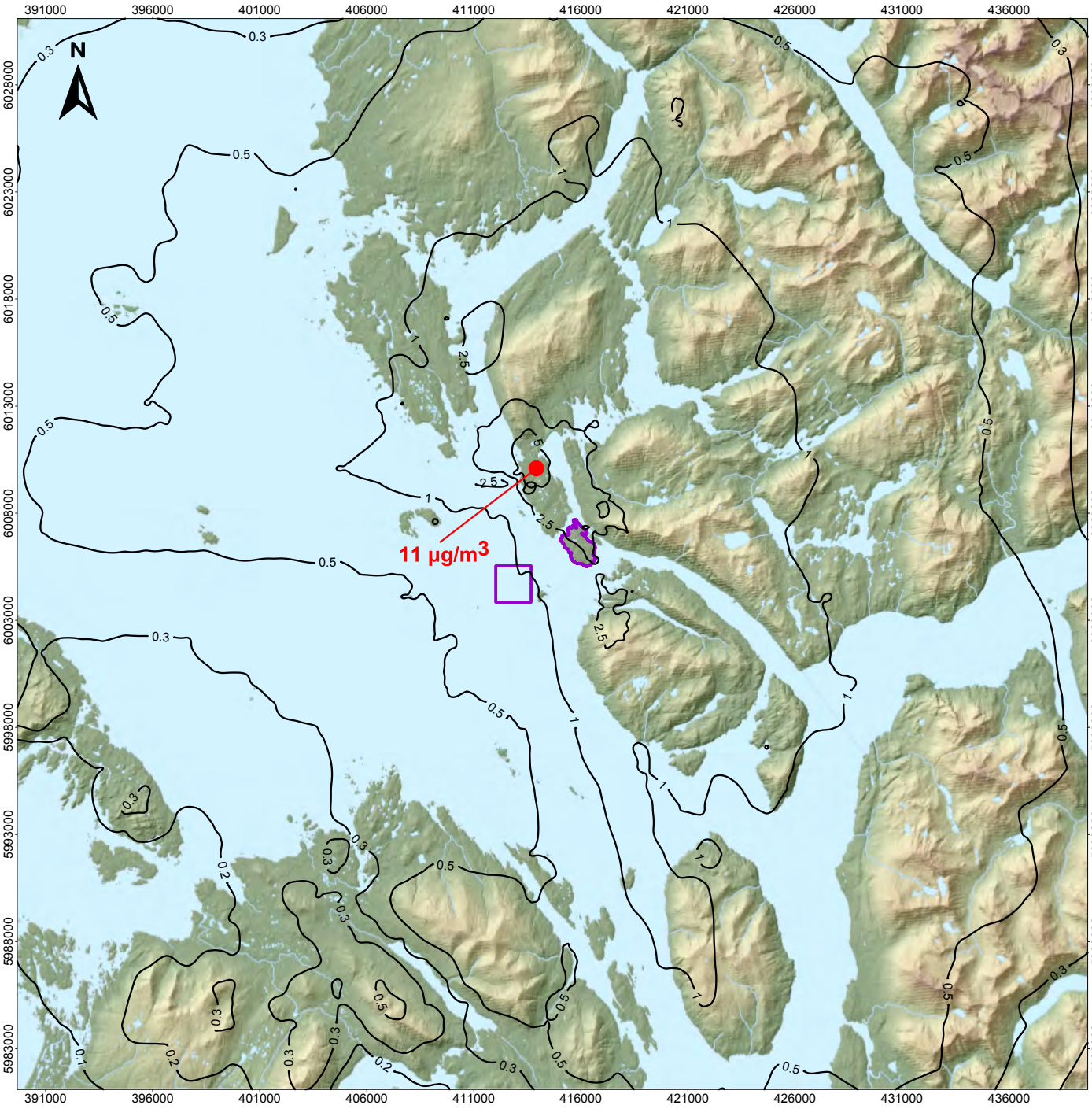
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	cu_NO2_ann	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-38**

V:\1231\active\EM\1231110537\disc_folders\air_quality\surfer\Isopleths\Cumulative\cu_NO2_ann.srf



Units: µg/m³
24-hr $PM_{2.5}$ AAQO = 25 µg/m³

- Maximum Concentration (µg/m³)
- Project Boundary

Pacific NorthWest LNG

98th Percentile 24-hour Average
Ground-level $PM_{2.5}$ Concentrations
Associated with the CEA Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

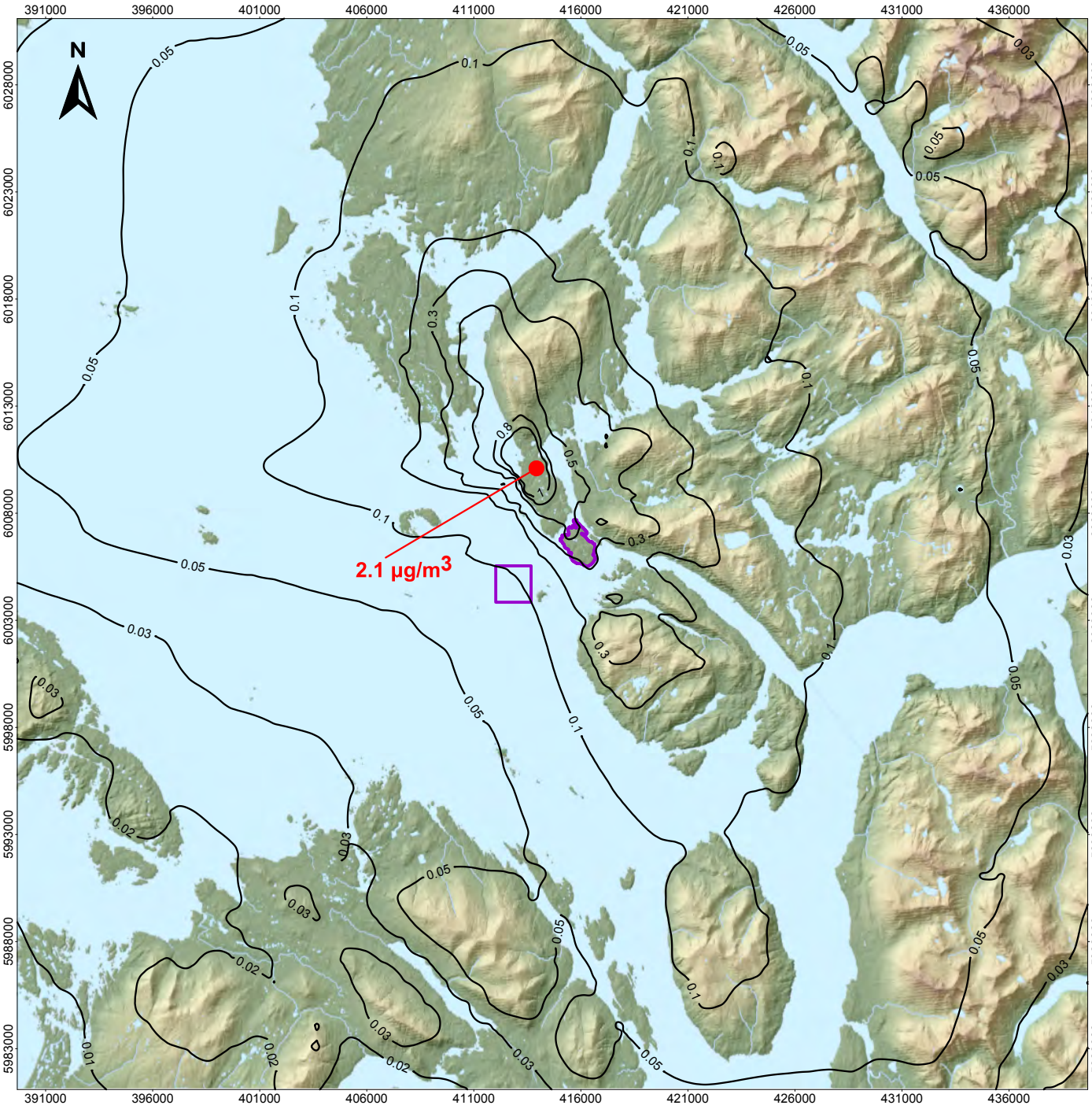
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	cu_PM2.5_24hr	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-39**

V:\1231\active\EM\1231 10537\disc_folders\air_quality\surfer\Isopleths\Cumulative\cu_PM2.5_24hr.srf



Units: µg/m³
Annual $PM_{2.5}$ AAQO = 8 µg/m³

Maximum Concentration (µg/m³)
Project Boundary

Pacific NorthWest LNG

Maximum Predicted Annual Average Ground-level $PM_{2.5}$ Concentrations Associated with the CEA Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

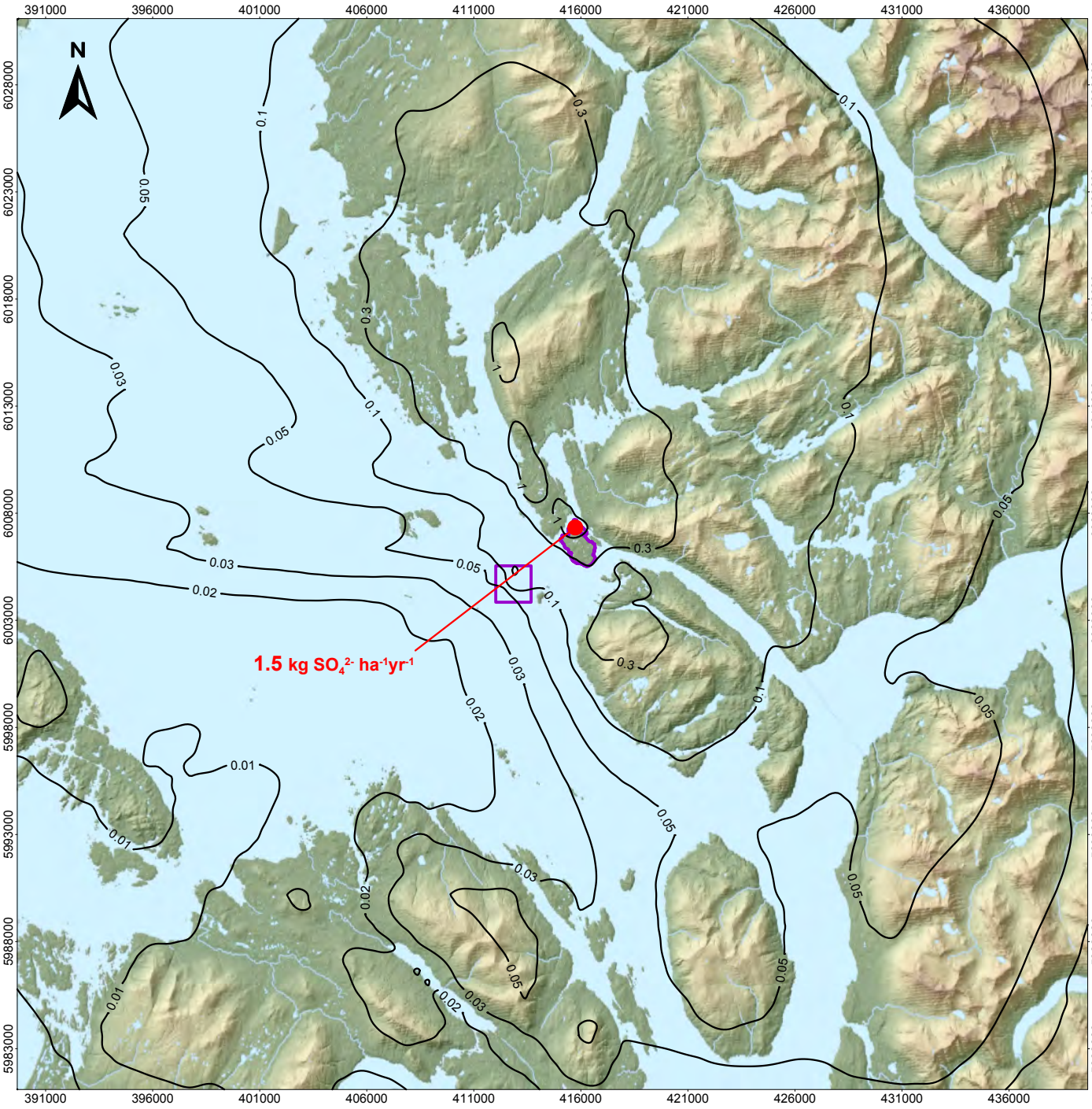
DATE:	21 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	cu_PM2.5_ann	DATUM:	NAD 83
DRAWN BY:	J. Gallagher	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-40**

V:\1231\active\EM\123110537\disc_folders\air_quality\surfer\Isopleths\Cumulative\cu_PM2.5_ann.srf



Maximum (kg SO_4^{2-} $ha^{-1}yr^{-1}$)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted Annual Average Sulphate Deposition Associated with the Application Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

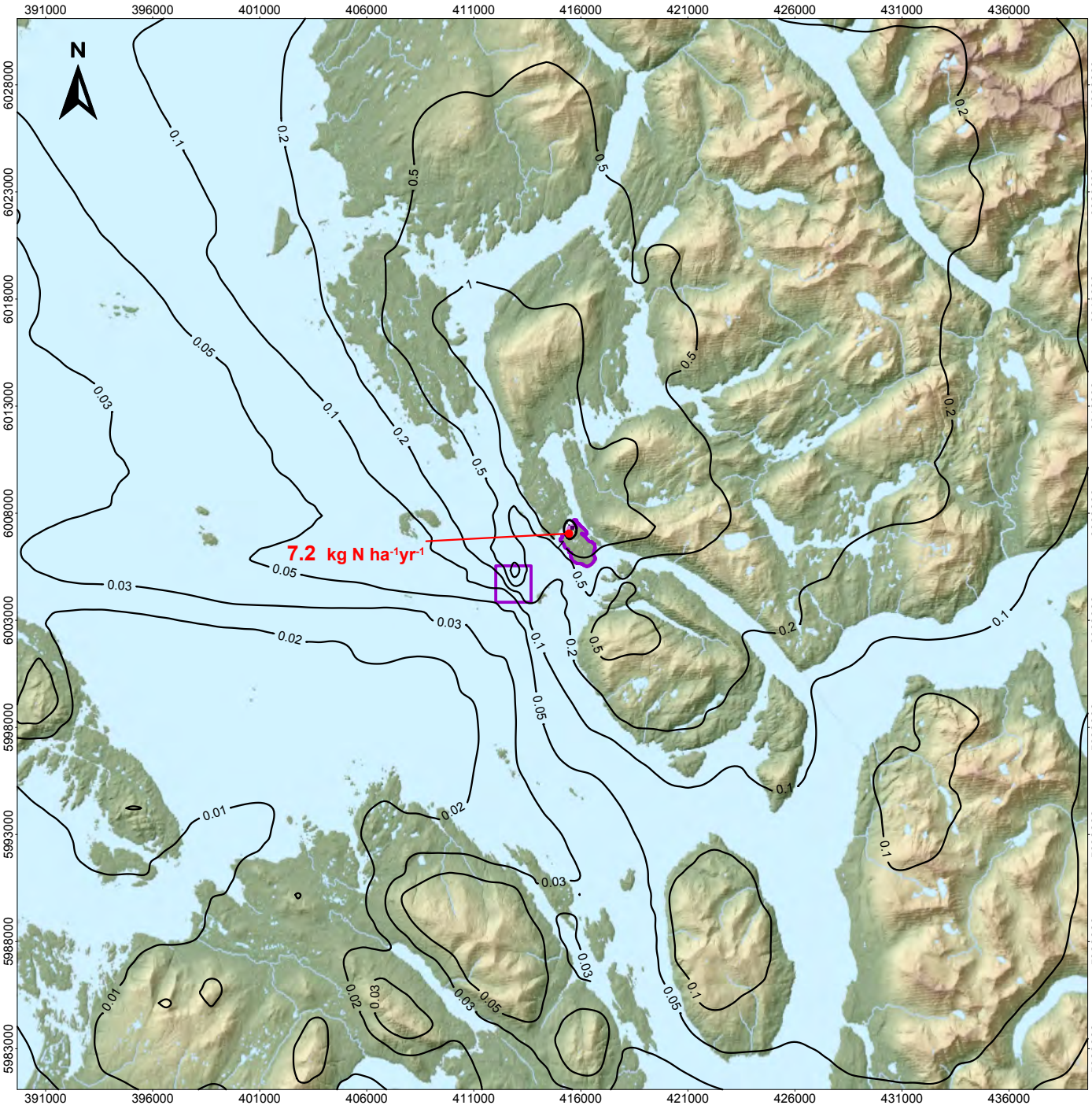
DATE:	25 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	ap_S_dep	DATUM:	NAD 83
DRAWN BY:	K. Wells	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-41**

V:\1231\active\EM\1231 10537\disc_folders\air_quality\surfer\Isopleths\Application\ap_S_dep.srf



MOE Critical Load: > 5 kg N ha^{-1}yr^{-1}
Units: kg N ha^{-1}yr^{-1}

Distance (m)
0 3000 6000 9000

- Maximum (kg N ha^{-1}yr^{-1})
- Project Boundary
- > 5 kg N ha^{-1}yr^{-1}

Pacific NorthWest LNG
Maximum Predicted Annual Average
Nitrogen Deposition
Associated with the Application Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

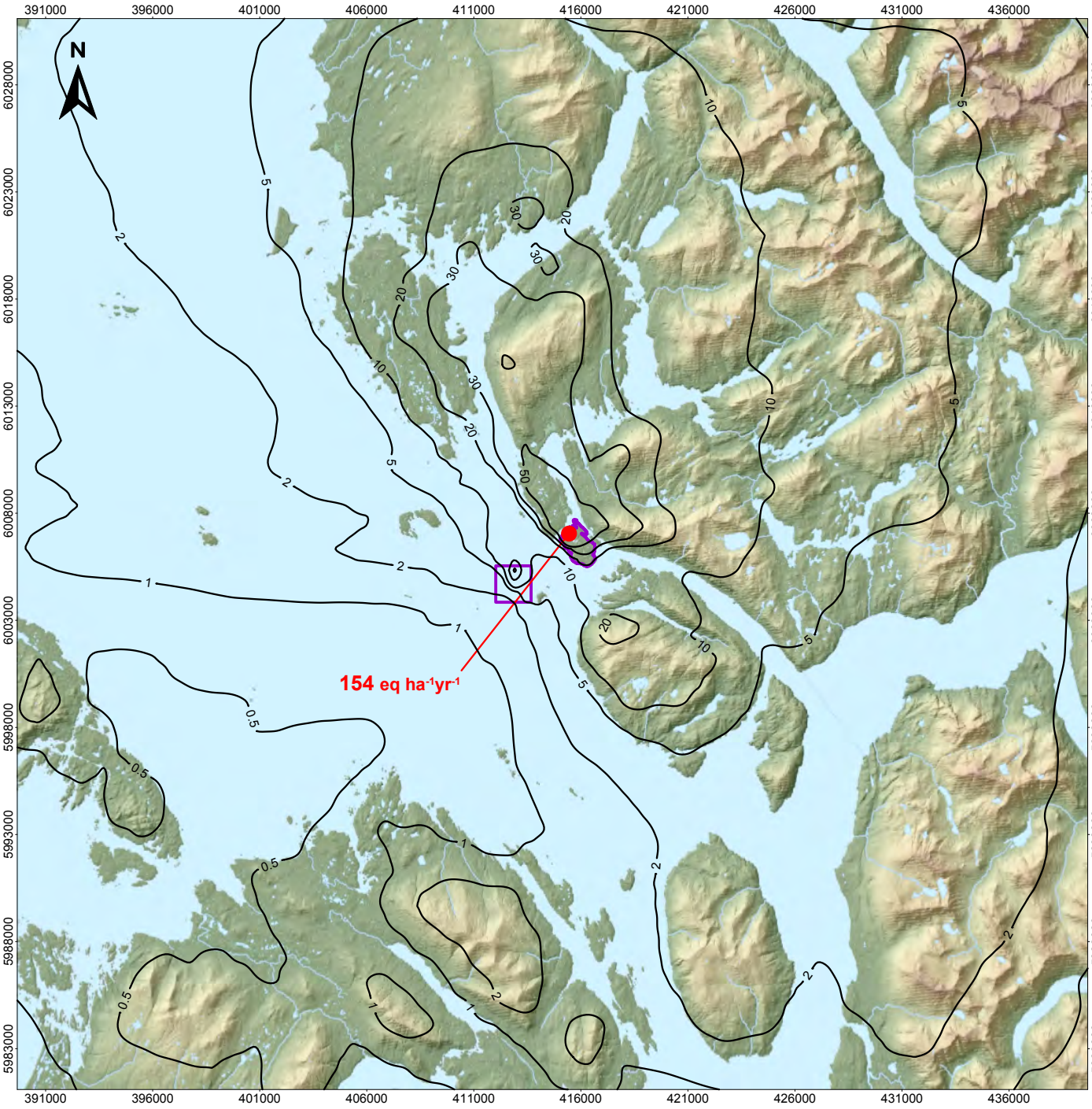
DATE:	25 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	ap_N_dep	DATUM:	NAD 83
DRAWN BY:	K. Wells	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-42**

V:\1231\active\EM\1231 10537\disc_folders\air_quality\surfer\Isopleths\Application\ap_N_dep.srf



Maximum (eq $ha^{-1}yr^{-1}$)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted Annual Average
PAI Associated with the Application Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

DATE:	25 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	ap_PAI	DATUM:	NAD 83
DRAWN BY:	K. Wells	CHECKED BY:	S. Banholzer

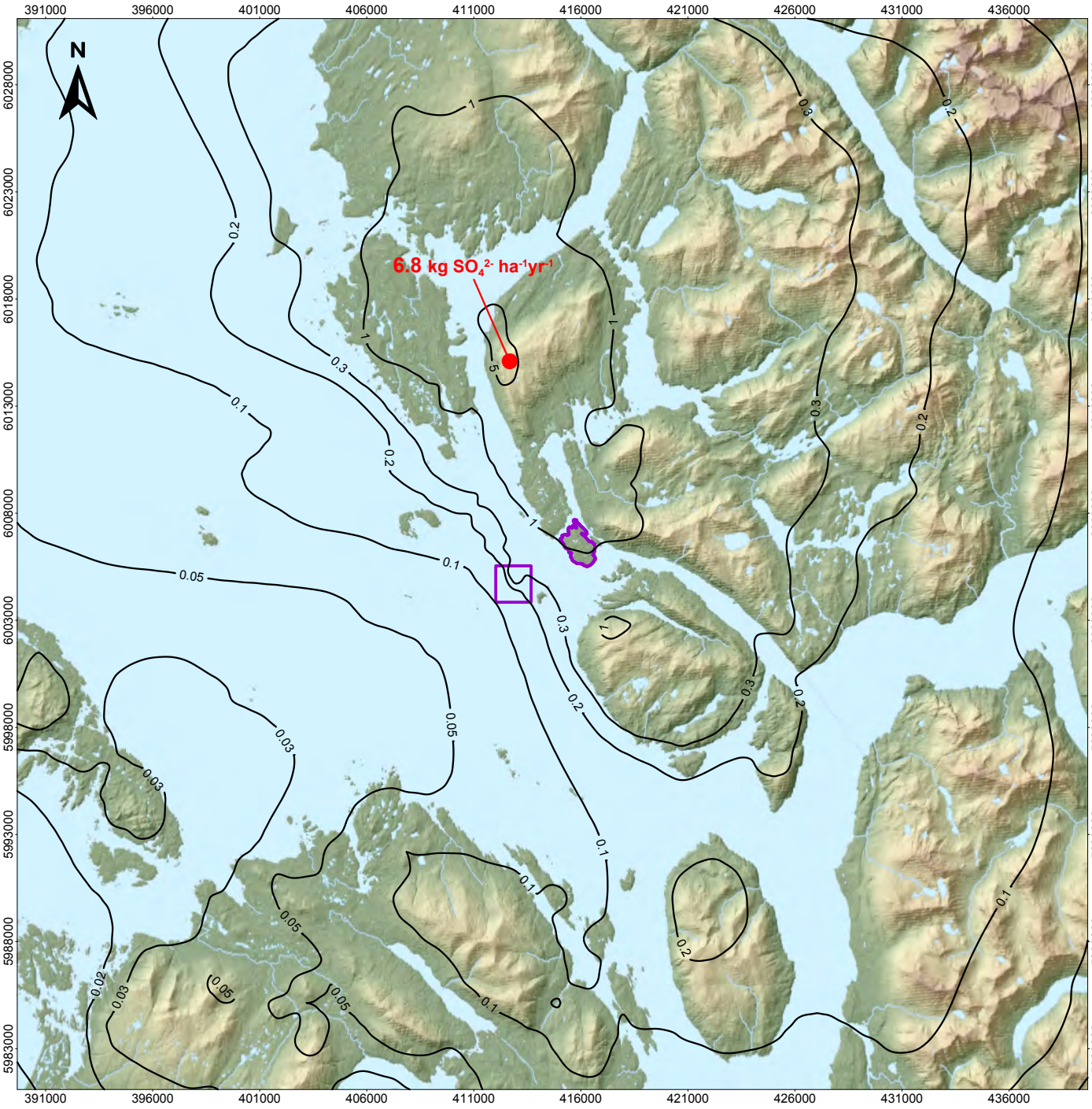
PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO:

7-43

V:\1231\active\EM\123110537\disc_folders\air_quality\surfer\Isopleths\Application\ap_PAI.srf



Maximum (kg SO_4^{2-} $ha^{-1}yr^{-1}$)

Project Boundary

Pacific NorthWest LNG

Maximum Predicted Annual Average
Sulphate Deposition
Associated with the CEA Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

DATE:	25 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	cu_S_dep	DATUM:	NAD 83
DRAWN BY:	K. Wells	CHECKED BY:	S. Banholzer

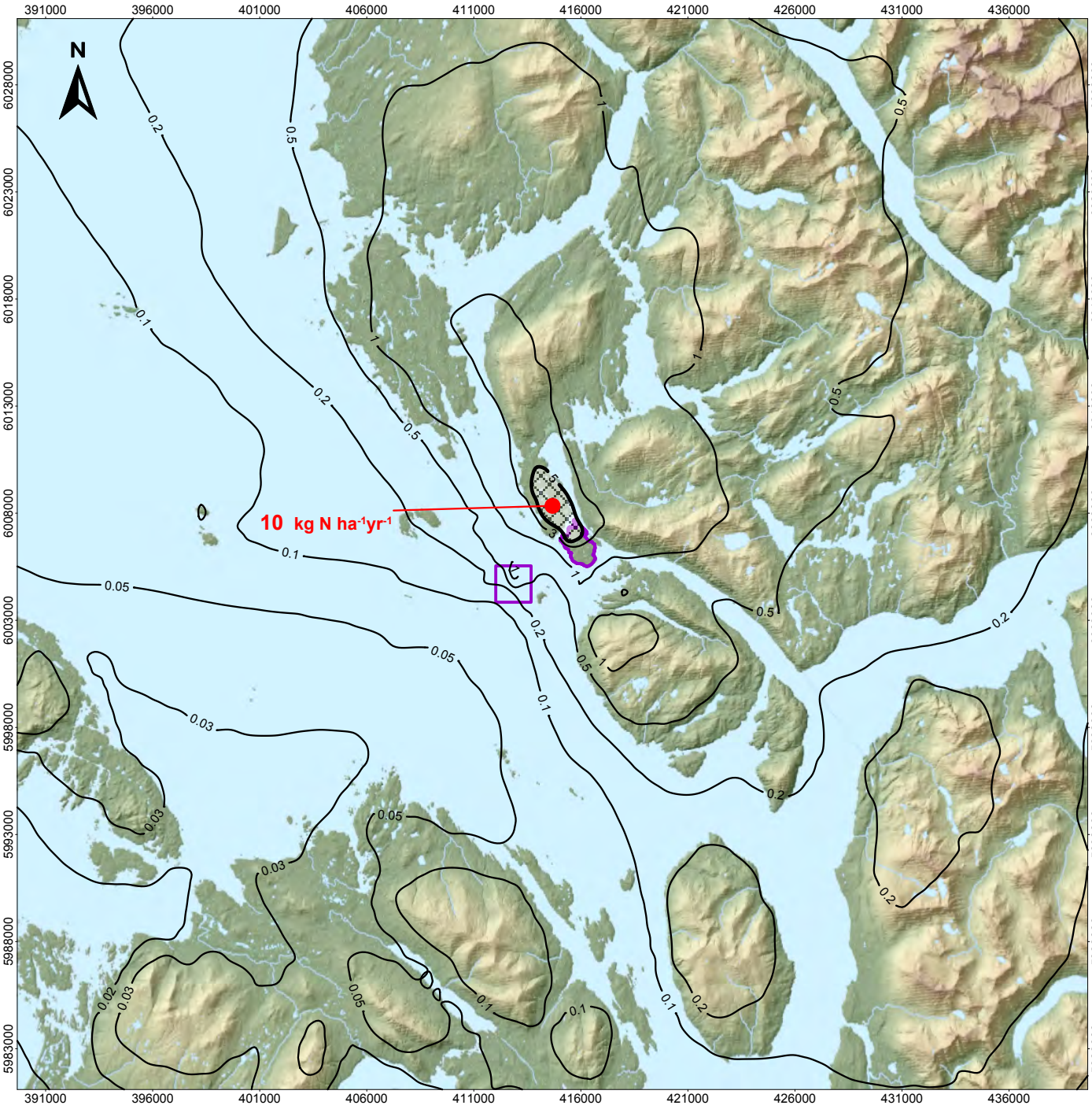
PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO:

7-44

V:\1231\active\EM\123110537\disc_folders\air_quality\surfer\Isopleths\Cumulative\cu_total_S_dep.srf



MOE Critical Load: > 5 kg N ha^{-1}yr^{-1}
Units: kg N ha^{-1}yr^{-1}

- Maximum (kg N ha^{-1}yr^{-1})
- Project Boundary
- > 5 kg N ha^{-1}yr^{-1}

Pacific NorthWest LNG
Maximum Predicted Annual Average
Nitrogen Deposition
Associated with the CEA Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

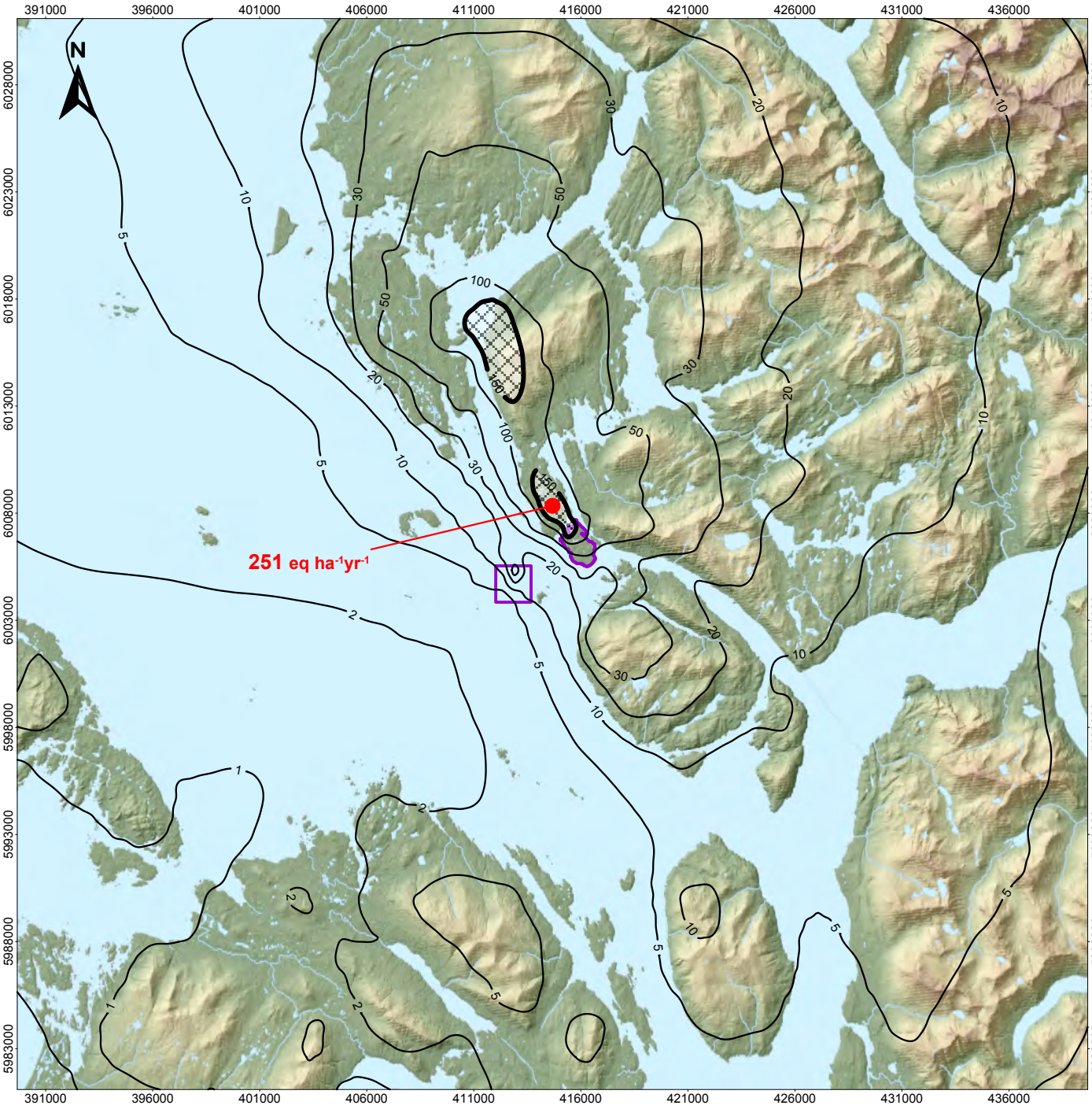
DATE:	25 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	cu_N_dep	DATUM:	NAD 83
DRAWN BY:	K. Wells	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO: **7-45**

V:\12311\active\EM\12311053\7\disc_folders\air_quality\surfer\Isopleths\Cumulative\cu_N_dep.srf



Maximum (eq $ha^{-1}yr^{-1}$)

Project Boundary

> 150 eq $ha^{-1}yr^{-1}$

Pacific NorthWest LNG

Maximum Predicted Annual Average
PAI Associated with the CEA Case

Sources: Natural Resources Canada.

Although there is no reason to believe that there are any errors associated with the data used to generate this product or in the product itself, users of these data are advised that errors in the data may be present

DATE:	25 - Nov - 2013	PROJECTION:	UTM - ZONE 9
FIGURE ID:	cu_PAI	DATUM:	NAD 83
DRAWN BY:	K. Wells	CHECKED BY:	S. Banholzer

PREPARED BY: Stantec

PREPARED FOR: Pacific NorthWest LNG

FIGURE NO:

7-46

V:\1231\active\EM\1231 10537\disc_folders\air_quality\surfer\Isopleths\Cumulative\cu_PAI.srf

APPENDIX 8

Sensitive Receptors

Pacific NorthWest LNG

Stantec

SENSITIVE RECEPTORS

Sensitive receptors are discrete locations of human and ecological importance: sensitive ecosystems (e.g. a lake), nearby homes, and places frequented by sensitive sub-populations of the community (e.g. children, the elderly, and those under medical care). These later locations include schools, medical treatment facilities, daycare facilities, and retirement homes.

The receptors represent locations of specific interest within the Regional Assessment Area (RAA). Forty-eight sensitive receptors were selected from within the RAA. The selection was based on locations of know human activities, residences, high populated areas, First Nation traditional land use areas, regional water bodies, and nearby islands. The following tables present predicted concentrations, in units of micrograms per cubic metre ($\mu g/m^3$), at each of the 48 sensitive receptors for the follow Criteria Air Contaminants and relevant averaging periods:

- 1-hour, 3-hour, 24-hour, and annual SO_2 at ground level (age)
- 1-hour, 3-hour, 24-hour, and annual SO_2 at 15 metres
- 1-hour, 24-hour, and annual NO_2
- 1-hour and 8-hour CO
- 24-hour and annual PM_{10}
- 24-hour and annual $PM_{2.5.}$

Maximum predicted concentrations at the sensitive receptors for the Baseline case, Project case, Application case, and Cumulative Effects Assessment case can be found in Table 8-1, 8-2, 8-3, and 8-4, respectively.

Table 8-1: Maximum Predicted Concentrations at Specified Sensitive Receptors for Baseline Case

#	Sensitive Receptor	Location (UTM NAD83)			$SO_{2\ agl}$				$SO_{2\ at\ 15m}$				NO_2			CO		PM_{10}		$PM_{2.5}$	
					$\mu g/m^3$				$\mu g/m^3$				$\mu g/m^3$			$\mu g/m^3$		$\mu g/m^3$		$\mu g/m^3$	
		Zone	mE	mN	1-hour	3-hour	24-hour	Annual	1-hour	3-hour	24-hour	Annual	1-hour	24-hour	Annual	1-hour	8-hour	24-hour	Annual	24-hour	Annual
1	Charles Hays Secondary	9	415148	6018920	8.52	5.87	2.61	0.29	10.6	6.85	2.16	0.30	26.0	3.32	0.46	28.8	7.03	1.20	0.09	0.74	0.067
2	Conrad Elementary School	9	415497	6019977	10.4	7.67	2.00	0.21	10.4	8.00	2.78	0.22	19.5	5.07	0.37	13.0	6.59	1.04	0.08	0.65	0.059
3	Lax Kxeen Elementary	9	414833	6019688	16.7	9.15	5.30	0.36	16.4	10.5	3.84	0.37	26.0	6.20	0.57	20.5	8.55	0.95	0.09	0.66	0.069
4	Hartley Bay Elementary Junior School	9	414701	6019593	14.7	8.87	4.04	0.46	15.4	10.6	4.08	0.46	27.1	5.42	0.66	21.2	8.76	0.95	0.10	0.69	0.073
5	Pacific Coast School	9	413750	6019199	21.4	10.4	2.60	0.23	16.0	8.62	2.86	0.25	42.5	9.28	0.61	43.4	14.5	1.08	0.11	0.95	0.085
6	Pineridge Elementary	9	413072	6017569	17.7	11.3	2.16	0.34	17.3	11.2	2.49	0.37	75.0	7.55	0.83	75.3	23.0	1.19	0.15	0.90	0.11
7	Port Edward Community School	9	416000	6008813	16.4	6.00	2.23	0.18	16.0	5.74	2.12	0.20	16.0	2.19	0.29	7.08	3.59	8.06	0.53	4.58	0.30
8	Prince Rupert Middle School	9	414271	6018650	14.3	6.75	2.38	0.27	12.5	8.82	3.15	0.29	30.1	4.22	0.51	28.7	7.87	0.85	0.10	0.63	0.074
9	Roosevelt Park Elementary (same as 5)	9	413671	6018447	13.7	8.68	2.25	0.27	12.0	9.90	2.49	0.28	54.0	6.67	0.59	52.5	11.8	0.86	0.12	0.72	0.087
10	First Nations Education	9	414323	6018829	15.4	7.06	2.61	0.33	12.6	10.7	4.19	0.34	26.9	4.74	0.56	24.1	8.35	0.84	0.10	0.65	0.074
11	Discovery Child Care	9	415307	6018937	8.71	6.01	2.17	0.27	11.0	6.92	2.24	0.28	24.9	3.25	0.43	28.4	6.87	1.29	0.09	0.78	0.065
12	Berry Patch Child Care	9	413806	6019276	31.4	11.4	2.77	0.21	14.4	8.33	2.78	0.23	39.5	8.92	0.59	40.4	14.6	1.07	0.11	0.94	0.084
13	Fellowship Baptist Nursery School	9	414793	6019593	13.1	8.00	3.87	0.40	13.9	10.1	3.42	0.40	25.6	5.32	0.60	20.1	8.16	0.94	0.10	0.66	0.070
14	KIDS Daycare	9	415573	6020077	9.32	7.62	2.01	0.20	9.58	7.96	2.61	0.21	20.0	5.10	0.36	12.8	6.56	1.01	0.08	0.63	0.057
15	Westview Child Care Centre	9	413671	6018447	13.7	8.68	2.25	0.27	12.0	9.90	2.49	0.28	54.0	6.67	0.59	52.5	11.8	0.86	0.12	0.72	0.087
16	Kaien Senior Citizen Housing	9	414576	6019595	18.8	12.2	4.96	0.55	20.7	11.9	5.06	0.55	28.6	5.76	0.76	23.2	9.69	0.93	0.10	0.72	0.077
17	Prince Rupert Regional Hospital	9	413374	6018191	11.7	8.24	2.25	0.28	12.0	10.4	2.78	0.30	71.7	7.23	0.67	70.8	15.8	0.90	0.13	0.74	0.10
18	Port Edward -residence	9	415968	6008506	10.7	4.83	1.49	0.17	12.2	6.35	1.94	0.20	12.0	2.05	0.28	6.79	3.68	7.93	0.49	4.53	0.28
19	Port Edward - residence	9	416039	6008371	9.14	5.08	1.49	0.17	10.4	7.03	1.85	0.19	10.9	1.96	0.28	6.60	3.61	7.61	0.48	4.35	0.28
20	Port Edward - residence	9	416092	6007960	8.17	3.47	1.39	0.16	9.30	7.46	1.64	0.18	11.1	1.86	0.26	6.06	3.58	7.17	0.44	4.09	0.25
21	Kitson Island campsite	9	414285	6004189	6.07	4.60	1.55	0.083	6.65	5.06	1.66	0.092	11.7	2.13	0.15	7.22	2.86	3.18	0.13	1.74	0.078
22	Kinahan Islands 1	9	408530	6008181	5.69	3.23	1.05	0.054	5.36	3.53	1.07	0.057	12.2	3.31	0.11	10.8	4.23	2.03	0.10	1.19	0.063
23	Rachael Islands	9	398370	6008130	3.92	2.03	0.66	0.035	3.42	2.06	0.65	0.038	5.85	1.15	0.06	6.71	2.01	1.17	0.06	0.66	0.035
24	Lucy Islands	9	394920	6017521	2.60	1.32	0.47	0.044	3.22	1.65	0.62	0.045	5.94	1.44	0.09	4.42	1.84	0.86	0.04	0.52	0.026
25	Digby Island	9	409847	6010580	5.88	4.23	2.32	0.16	6.00	4.58	2.36	0.17	22.9	7.54	0.28	20.7	7.63	3.93	0.42	2.32	0.24
26	Smith Island	9	417967	6005696	5.27	3.66	1.03	0.088	5.30	3.66	1.10	0.10	6.54	1.34	0.15	4.03	2.36	3.16	0.20	1.88	0.12
27	Kinahan Islands 2	9	408272	6006828	6.81	4.28	0.99	0.038	6.54	4.39	1.04	0.040	9.87	2.81	0.085	8.67	3.49	1.85	0.07	1.13	0.045
28	Rachael Islands 2	9	398403	6006533	1.90	1.47	0.47	0.021	2.35	1.50	0.48	0.023	5.10	0.90	0.046	5.91	1.69	0.79	0.04	0.46	0.023
29	Porcher Island Northwest	9	398298	5989431	1.89	1.00	0.20	0.007	1.91	1.02	0.20	0.008	4.32	0.40	0.015	2.49	0.72	0.26	0.01	0.16	0.007
30	Porcher Island - Hunts Inlet	9	405553	5992085	1.27	0.88	0.28	0.012	1.69	0.89	0.28	0.012	3.29	0.74	0.023	1.92	1.04	0.38	0.02	0.24	0.012
31	Porcher Island North	9	408871	5994124	2.33	1.58	0.37	0.015	1.81	1.18	0.38	0.016	3.70	1.13	0.032	2.54	1.12	0.58	0.03	0.36	0.017
32	Osland Village	9	424115	5999346	1.94	1.13	0.34	0.032	2.02	1.16	0.32	0.032	2.95	0.56	0.050	1.72	0.61	0.55	0.05	0.35	0.033
33	Metlakatla First Nations	9	405967	6021882	3.72	2.64	0.82	0.11	3.54	2.64	0.92	0.12	13.7	2.21	0.27	12.5	3.83	0.64	0.06	0.42	0.044

#	Sensitive Receptor	Location (UTM NAD83)			$SO_{2\ agl}$ µg/m³				$SO_{2\ at\ 15m}$ µg/m³				NO_2 µg/m³			CO µg/m³		PM_{10} µg/m³		$PM_{2.5}$ µg/m³	
		Zone	mE	mN	1-hour	3-hour	24-hour	Annual	1-hour	3-hour	24-hour	Annual	1-hour	24-hour	Annual	1-hour	8-hour	24-hour	Annual	24-hour	Annual
34	Digby Island - Dodge Cove	9	409883	6016045	14.4	10.1	3.70	0.39	14.4	10.7	3.81	0.38	178	32.8	1.81	160	58.1	2.36	0.28	2.27	0.20
35	ICEC Terminals	9	413506	6009025	24.4	18.4	7.28	0.67	22.4	18.6	6.80	0.74	22.2	5.66	0.76	11.9	6.05	13.3	1.38	8.21	0.84
36	Port Edward - Commercial	9	416780	6006922	5.45	3.52	1.09	0.10	6.50	4.25	1.18	0.12	7.93	1.58	0.19	4.81	2.96	4.22	0.26	2.49	0.15
37	Cannery Museum and Village	9	420099	6005868	2.65	1.82	0.51	0.061	3.11	2.14	0.54	0.066	4.84	0.82	0.10	3.74	1.06	1.42	0.11	0.90	0.068
38	Old Cannery	9	423153	6003964	2.07	1.41	0.39	0.042	2.07	1.42	0.38	0.043	3.29	0.62	0.066	2.23	0.68	0.85	0.07	0.53	0.044
39	Metlakatla Sandbar	9	404285	6021789	4.34	3.08	0.86	0.094	4.61	4.14	1.21	0.097	10.7	2.27	0.22	10.1	3.21	0.48	0.05	0.31	0.036
40	West-side Kaien Island	9	413901	6009149	18.9	13.2	4.81	0.49	24.0	12.7	4.59	0.55	22.0	4.60	0.65	10.6	6.36	11.5	1.51	6.55	0.87
41	Sand Bar North of Casey Point	9	411825	6013986	10.7	6.18	2.77	0.33	11.1	8.2	3.57	0.36	86.2	20.27	1.22	79.2	41.3	3.14	0.36	1.79	0.24
42	North End of Porcher Island	9	406964	5994583	1.98	1.36	0.51	0.018	3.84	1.66	0.50	0.021	5.07	1.23	0.035	3.58	1.53	0.63	0.03	0.39	0.018
43	Ridley Island	9	413919	6008375	14.6	9.66	4.41	0.39	14.3	11.1	4.77	0.43	18.4	5.65	0.52	10.5	5.42	8.09	0.72	4.58	0.43
44	Sand Bar North of Casey Point	9	411825	6013986	10.7	6.18	2.77	0.33	11.1	8.18	3.57	0.36	86.2	20.27	1.22	79.2	41.3	3.14	0.36	1.79	0.24
45	Pike Island	9	405106	6020457	5.00	2.99	0.89	0.11	6.56	4.54	1.28	0.11	14.8	3.05	0.25	13.0	4.28	0.56	0.06	0.37	0.042
46	Alwyn Lake	9	419405	6008531	4.66	3.09	0.93	0.082	4.16	3.31	0.86	0.083	5.80	1.01	0.12	3.73	1.22	1.86	0.16	1.10	0.10
47	Woodworth Lake	9	424060	6022558	2.23	1.98	0.40	0.032	2.21	1.95	0.38	0.032	3.93	0.74	0.054	2.36	0.83	0.36	0.03	0.24	0.018
48	Shawatlans Lake	9	419531	6021359	3.95	2.81	0.84	0.059	3.97	3.19	1.03	0.061	7.44	2.10	0.11	5.46	1.99	0.55	0.05	0.34	0.032

Table 8-2: Maximum Predicted Concentrations at Specified Sensitive Receptors for the Project – Alone Case

#	Sensitive Receptor	Location (UTM NAD83)			$SO_{2\ agl}$				$SO_{2\ at\ 15m}$				NO_2			CO		PM_{10}		$PM_{2.5}$	
					µg/m^3				µg/m^3				µg/m^3			µg/m^3		µg/m^3		µg/m^3	
		Zone	mE	mN	1-hour	3-hour	24-hour	Annual	1-hour	3-hour	24-hour	Annual	1-hour	24-hour	Annual	1-hour	8-hour	24-hour	Annual	24-hour	Annual
1	Charles Hays Secondary	9	415148	6018920	1.56	1.10	0.35	0.030	1.57	1.10	0.36	0.03	15.8	3.41	0.41	14.4	5.84	0.57	0.046	0.56	0.046
2	Conrad Elementary School	9	415497	6019977	1.37	0.97	0.35	0.028	1.38	0.97	0.35	0.028	14.4	3.29	0.38	13.2	5.23	0.59	0.045	0.59	0.045
3	Lax Kxeen Elementary	9	414833	6019688	1.47	1.02	0.34	0.029	1.48	1.02	0.34	0.029	16.8	3.52	0.39	12.9	5.62	0.56	0.044	0.56	0.044
4	Hartley Bay Elementary Junior School	9	414701	6019593	1.49	1.04	0.34	0.030	1.49	1.04	0.34	0.030	17.5	3.62	0.40	12.9	5.63	0.56	0.044	0.56	0.044
5	Pacific Coast School	9	413750	6019199	1.49	0.92	0.29	0.032	1.49	0.92	0.29	0.032	18.2	3.61	0.41	12.0	5.15	0.57	0.044	0.57	0.044
6	Pineridge Elementary	9	413072	6017569	1.63	1.01	0.32	0.039	1.63	1.02	0.32	0.039	18.2	3.70	0.48	19.8	6.07	0.59	0.048	0.58	0.047
7	Port Edward Community School	9	416000	6008813	7.73	3.81	1.49	0.165	7.77	3.82	1.52	0.17	45.2	8.59	1.15	58.7	16.7	0.87	0.106	0.87	0.106
8	Prince Rupert Middle School	9	414271	6018650	1.38	1.02	0.31	0.031	1.38	1.02	0.31	0.031	17.5	3.51	0.41	13.4	6.16	0.58	0.045	0.58	0.045
9	Roosevelt Park Elementary (same as 5)	9	413671	6018447	1.53	1.05	0.31	0.036	1.53	1.05	0.31	0.036	20.9	3.94	0.46	17.6	6.05	0.58	0.048	0.58	0.048
10	First Nations Education	9	414323	6018829	1.36	1.01	0.31	0.031	1.37	1.01	0.31	0.031	17.3	3.51	0.40	13.2	6.12	0.57	0.044	0.57	0.044
11	Discovery Child Care	9	415307	6018937	1.60	1.12	0.36	0.030	1.61	1.12	0.36	0.030	15.4	3.42	0.41	14.4	5.76	0.58	0.047	0.58	0.047
12	Berry Patch Child Care	9	413806	6019276	1.48	0.92	0.29	0.032	1.48	0.92	0.29	0.032	18.0	3.60	0.41	11.5	5.17	0.56	0.044	0.56	0.044
13	Fellowship Baptist Nursery School	9	414793	6019593	1.47	1.02	0.34	0.029	1.47	1.02	0.34	0.029	16.8	3.52	0.39	13.0	5.64	0.56	0.044	0.56	0.044
14	KIDS Daycare	9	415573	6020077	1.34	0.94	0.34	0.028	1.34	0.94	0.34	0.028	13.9	3.23	0.37	13.2	5.12	0.60	0.044	0.59	0.044
15	Westview Child Care Centre	9	413671	6018447	1.53	1.05	0.31	0.036	1.53	1.05	0.31	0.036	20.9	3.94	0.46	17.6	6.05	0.58	0.048	0.58	0.048
16	Kaien Senior Citizen Housing	9	414576	6019595	1.50	1.05	0.34	0.030	1.50	1.05	0.34	0.030	18.1	3.70	0.40	12.4	5.76	0.56	0.045	0.56	0.044
17	Prince Rupert Regional Hospital	9	413374	6018191	1.61	1.12	0.31	0.037	1.61	1.13	0.31	0.037	19.4	3.66	0.47	16.5	6.22	0.59	0.048	0.58	0.047
18	Port Edward -residence	9	415968	6008506	7.38	3.82	1.39	0.17	7.43	3.83	1.42	0.17	44.1	8.27	1.19	60.7	16.8	0.89	0.11	0.89	0.109
19	Port Edward - residence	9	416039	6008371	9.08	4.82	1.58	0.17	9.12	4.84	1.61	0.17	47.6	9.19	1.19	74.1	16.9	0.93	0.11	0.93	0.110
20	Port Edward - residence	9	416092	6007960	11.9	7.60	1.80	0.19	11.9	7.60	1.84	0.19	53.3	9.93	1.33	90.0	21.0	0.98	0.12	0.98	0.122
21	Kitson Island campsite	9	414285	6004189	2.31	1.55	0.74	0.011	2.33	1.56	0.87	0.013	111	25.2	0.35	15.4	7.06	0.87	0.012	0.87	0.012
22	Kinahan Islands 1	9	408530	6008181	6.55	3.14	0.39	0.017	6.55	3.15	0.39	0.018	31.3	6.15	0.23	37.9	6.85	0.59	0.014	0.59	0.014
23	Rachael Islands	9	398370	6008130	3.22	2.33	0.52	0.021	3.24	2.35	0.52	0.021	25.2	5.77	0.20	20.3	10.1	0.48	0.016	0.48	0.016
24	Lucy Islands	9	394920	6017521	1.45	0.86	0.25	0.009	1.47	0.86	0.26	0.009	9.92	3.02	0.089	9.33	4.25	0.34	0.008	0.34	0.008
25	Digby Island	9	409847	6010580	2.33	1.43	0.35	0.035	2.33	1.44	0.36	0.036	39.8	5.84	0.37	19.7	7.15	0.55	0.025	0.55	0.025
26	Smith Island	9	417967	6005696	4.93	3.67	1.03	0.059	4.93	3.67	1.04	0.060	39.2	5.75	0.37	40.3	16.2	1.44	0.045	1.44	0.045
27	Kinahan Islands 2	9	408272	6006828	3.28	1.83	0.59	0.029	3.28	1.83	0.61	0.031	26.9	5.07	0.25	29.9	10.8	0.61	0.020	0.61	0.020
28	Rachael Islands 2	9	398403	6006533	2.18	1.41	0.69	0.025	2.18	1.41	0.69	0.026	18.3	5.86	0.21	14.1	9.65	0.49	0.016	0.49	0.016
29	Porcher Island Northwest	9	398298	5989431	0.33	0.24	0.04	0.002	0.33	0.24	0.04	0.002	4.70	0.67	0.018	3.71	0.89	0.22	0.003	0.22	0.003
30	Porcher Island - Hunts Inlet	9	405553	5992085	0.92	0.50	0.15	0.003	0.92	0.50	0.15	0.003	9.33	2.31	0.031	6.66	2.52	0.47	0.005	0.47	0.005
31	Porcher Island North	9	408871	5994124	0.74	0.47	0.11	0.003	0.75	0.48	0.11	0.003	7.83	1.52	0.025	7.30	2.45	0.60	0.005	0.60	0.005
32	Osland Village	9	424115	5999346	1.53	0.88	0.31	0.023	1.53	0.88	0.31	0.023	15.1	3.43	0.22	35.4	8.51	0.70	0.033	0.70	0.033
33	Metlakatla First Nations	9	405967	6021882	0.92	0.57	0.20	0.021	0.92	0.57	0.20	0.021	8.04	2.00	0.24	7.16	3.54	0.34	0.022	0.34	0.022

#	Sensitive Receptor	Location (UTM NAD83)			$SO_{2\ agl}$				$SO_{2\ at\ 15m}$				NO_2			CO		PM_{10}		$PM_{2.5}$	
					$\mu g/m^3$				$\mu g/m^3$				$\mu g/m^3$			$\mu g/m^3$		$\mu g/m^3$		$\mu g/m^3$	
		Zone	mE	mN	1-hour	3-hour	24-hour	Annual	1-hour	3-hour	24-hour	Annual	1-hour	24-hour	Annual	1-hour	8-hour	24-hour	Annual	24-hour	Annual
34	Digby Island - Dodge Cove	9	409883	6016045	1.49	1.04	0.29	0.038	1.49	1.04	0.29	0.038	16.7	3.18	0.42	15.0	5.40	0.49	0.037	0.49	0.037
35	ICEC Terminals	9	413506	6009025	4.05	3.47	1.00	0.12	4.04	3.46	1.00	0.12	62.3	14.1	0.99	29.1	13.9	0.72	0.074	0.72	0.074
36	Port Edward - Commercial	9	416780	6006922	14.4	10.8	1.86	0.10	14.3	10.8	1.89	0.10	60.0	13.8	0.65	114	33.5	1.60	0.066	1.60	0.066
37	Cannery Museum and Village	9	420099	6005868	3.57	2.04	0.74	0.036	3.58	2.04	0.74	0.036	27.1	5.73	0.27	51.4	12.5	1.69	0.041	1.69	0.041
38	Old Cannery	9	423153	6003964	2.07	1.25	0.32	0.023	2.07	1.25	0.32	0.023	15.7	3.06	0.19	29.0	7.61	1.30	0.034	1.30	0.034
39	Metlakatla Sandbar	9	404285	6021789	0.91	0.62	0.27	0.020	0.91	0.62	0.27	0.020	10.4	2.73	0.22	7.56	2.73	0.33	0.019	0.33	0.019
40	West-side Kaien Island	9	413901	6009149	4.33	2.65	1.27	0.15	4.32	2.64	1.27	0.15	68.1	10.1	1.16	30.8	17.3	0.93	0.090	0.93	0.090
41	Sand Bar North of Casey Point	9	411825	6013986	2.00	1.27	0.39	0.049	2.01	1.27	0.40	0.049	29.6	4.98	0.58	15.2	7.83	0.50	0.047	0.50	0.047
42	North End of Porcher Island	9	406964	5994583	0.98	0.45	0.12	0.003	0.99	0.46	0.12	0.003	13.9	1.98	0.03	9.42	2.35	0.57	0.005	0.57	0.005
43	Ridley Island	9	413919	6008375	4.72	4.17	1.44	0.14	4.71	4.16	1.44	0.14	41.8	9.74	1.09	37.3	17.0	0.84	0.084	0.84	0.084
44	Sand Bar North of Casey Point	9	411825	6013986	2.00	1.27	0.39	0.049	2.01	1.27	0.40	0.049	29.6	4.98	0.58	15.2	7.83	0.50	0.047	0.50	0.047
45	Pike Island	9	405106	6020457	1.04	0.73	0.30	0.022	1.05	0.73	0.30	0.022	12.0	3.07	0.24	8.31	2.99	0.36	0.021	0.36	0.021
46	Alwyn Lake	9	419405	6008531	4.97	2.80	1.03	0.058	4.99	2.80	1.03	0.058	41.6	11.0	0.54	37.1	20.1	1.15	0.059	1.14	0.059
47	Woodworth Lake	9	424060	6022558	0.99	0.63	0.16	0.013	0.99	0.63	0.16	0.013	11.1	2.31	0.16	13.9	3.72	1.01	0.026	1.01	0.026
48	Shawatlans Lake	9	419531	6021359	1.13	0.86	0.27	0.019	1.13	0.86	0.27	0.020	11.4	3.08	0.23	13.8	5.58	0.93	0.036	0.93	0.036

Table 8-3: Maximum Predicted Concentrations at Specified Sensitive Receptors for the Application Case

#	Sensitive Receptor	Location (UTM NAD83)			$SO_{2\ agl}$				$SO_{2\ at\ 15m}$				NO_2			CO		PM_{10}		$PM_{2.5}$	
					µg/m^3				µg/m^3				µg/m^3			µg/m^3		µg/m^3		µg/m^3	
		Zone	mE	mN	1-hour	3-hour	24-hour	Annual	1-hour	3-hour	24-hour	Annual	1-hour	24-hour	Annual	1-hour	8-hour	24-hour	Annual	24-hour	Annual
1	Charles Hays Secondary	9	415148	6018920	10.6	6.50	2.14	0.32	10.6	6.85	2.16	0.33	26.0	4.77	0.87	28.8	8.22	1.24	0.14	0.98	0.11
2	Conrad Elementary School	9	415497	6019977	10.4	8.00	2.65	0.25	10.4	8.00	2.78	0.25	19.5	6.13	0.75	13.5	6.59	1.25	0.13	1.10	0.10
3	Lax Kxeen Elementary	9	414833	6019688	16.5	10.6	3.66	0.39	16.4	10.5	3.84	0.40	26.0	6.22	0.96	20.5	8.56	1.24	0.14	1.10	0.11
4	Hartley Bay Elementary Junior School	9	414701	6019593	15.5	10.7	4.04	0.48	15.5	10.6	4.08	0.49	27.1	6.37	1.06	21.2	8.77	1.24	0.14	1.10	0.12
5	Pacific Coast School	9	413750	6019199	16.0	8.62	2.92	0.27	16.0	8.62	2.93	0.28	42.8	10.1	1.03	43.5	14.6	1.31	0.16	1.18	0.13
6	Pineridge Elementary	9	413072	6017569	17.7	11.2	2.42	0.40	17.3	11.2	2.55	0.41	75.0	9.40	1.31	75.3	23.7	1.41	0.20	1.22	0.16
7	Port Edward Community School	9	416000	6008813	16.3	5.90	2.15	0.36	16.0	5.74	2.18	0.37	45.2	8.60	1.44	58.7	16.7	8.28	0.64	4.80	0.41
8	Prince Rupert Middle School	9	414271	6018650	11.8	8.86	3.16	0.32	12.5	8.82	3.15	0.32	30.1	5.16	0.92	28.7	8.40	1.14	0.15	1.00	0.12
9	Roosevelt Park Elementary (same as 5)	9	413671	6018447	11.2	9.13	2.49	0.31	12.0	9.90	2.58	0.32	54.5	7.50	1.05	52.5	13.7	1.31	0.17	1.13	0.13
10	First Nations Education	9	414323	6018829	12.7	10.7	4.21	0.37	12.6	10.7	4.19	0.37	26.9	5.67	0.97	24.1	8.79	1.11	0.15	0.97	0.12
11	Discovery Child Care	9	415307	6018937	11.1	6.95	2.22	0.31	11.0	6.93	2.24	0.31	24.9	4.69	0.84	28.4	8.10	1.33	0.14	1.00	0.11
12	Berry Patch Child Care	9	413806	6019276	14.1	8.25	2.77	0.26	14.4	8.33	2.78	0.26	39.8	9.72	1.00	40.5	14.6	1.31	0.15	1.19	0.13
13	Fellowship Baptist Nursery School	9	414793	6019593	14.1	10.2	3.40	0.43	14.0	10.1	3.42	0.43	25.6	6.13	0.99	20.1	8.17	1.23	0.14	1.09	0.11
14	KIDS Daycare	9	415573	6020077	9.57	7.96	2.48	0.24	9.58	7.96	2.61	0.24	20.0	6.17	0.73	13.9	6.56	1.26	0.12	1.11	0.10
15	Westview Child Care Centre	9	413671	6018447	11.2	9.13	2.49	0.31	12.0	9.90	2.58	0.32	54.5	7.50	1.05	52.5	13.7	1.31	0.17	1.13	0.13
16	Kaien Senior Citizen Housing	9	414576	6019595	20.8	11.9	4.96	0.57	20.7	11.9	5.06	0.58	28.6	6.68	1.16	23.3	9.69	1.27	0.15	1.13	0.12
17	Prince Rupert Regional Hospital	9	413374	6018191	12.0	10.6	2.75	0.33	12.0	10.4	2.84	0.34	72.1	8.18	1.13	70.9	18.0	1.37	0.18	1.18	0.14
18	Port Edward -residence	9	415968	6008506	12.3	5.92	1.97	0.36	12.2	6.35	2.00	0.37	44.1	8.83	1.47	60.7	16.8	8.13	0.60	4.72	0.39
19	Port Edward - residence	9	416039	6008371	10.5	6.63	1.86	0.36	10.5	7.03	1.92	0.36	47.6	9.22	1.47	74.2	17.0	7.80	0.59	4.53	0.38
20	Port Edward - residence	9	416092	6007960	12.0	7.60	2.61	0.37	12.0	7.60	2.62	0.37	53.4	9.93	1.59	90.0	21.1	7.33	0.56	4.25	0.38
21	Kitson Island campsite	9	414285	6004189	6.07	4.60	1.58	0.10	6.65	5.06	1.69	0.10	111	25.9	0.50	15.8	7.43	3.18	0.14	1.74	0.09
22	Kinahan Islands 1	9	408530	6008181	6.90	3.47	1.06	0.073	6.90	3.53	1.07	0.075	31.3	6.83	0.34	38.0	6.92	2.03	0.12	1.19	0.08
23	Rachael Islands	9	398370	6008130	3.77	3.04	0.88	0.058	4.11	3.21	0.93	0.059	25.6	5.77	0.26	20.3	11.0	1.20	0.07	0.73	0.05
24	Lucy Islands	9	394920	6017521	3.10	1.57	0.66	0.054	3.23	1.65	0.66	0.054	10.1	3.29	0.18	9.37	4.28	0.95	0.05	0.61	0.03
25	Digby Island	9	409847	6010580	6.28	5.21	2.60	0.20	6.27	5.32	2.64	0.21	39.8	7.63	0.65	20.9	7.74	4.03	0.45	2.42	0.26
26	Smith Island	9	417967	6005696	5.48	3.85	1.51	0.16	5.47	3.84	1.52	0.16	39.2	5.83	0.52	40.3	16.3	3.18	0.24	1.99	0.16
27	Kinahan Islands 2	9	408272	6006828	5.99	4.34	1.00	0.068	6.54	4.39	1.04	0.071	26.9	5.34	0.34	29.9	10.8	1.85	0.09	1.13	0.06
28	Rachael Islands 2	9	398403	6006533	2.38	1.48	0.77	0.048	2.38	1.51	0.79	0.049	18.3	5.86	0.25	14.1	9.65	0.79	0.05	0.64	0.04
29	Porcher Island Northwest	9	398298	5989431	1.90	1.03	0.21	0.009	1.93	1.05	0.22	0.009	5.34	0.95	0.032	3.71	0.96	0.28	0.01	0.27	0.01
30	Porcher Island - Hunts Inlet	9	405553	5992085	1.77	0.92	0.43	0.015	1.76	0.94	0.43	0.015	9.39	2.83	0.054	6.77	2.57	0.69	0.02	0.65	0.02
31	Porcher Island North	9	408871	5994124	1.79	1.23	0.39	0.019	1.86	1.24	0.41	0.019	8.51	1.99	0.057	7.46	2.45	1.06	0.03	0.96	0.02
32	Osland Village	9	424115	5999346	2.02	1.21	0.59	0.054	2.03	1.22	0.59	0.055	15.3	3.55	0.27	35.4	8.52	1.26	0.08	1.05	0.07
33	Metlakatla First Nations	9	405967	6021882	3.88	3.18	1.13	0.14	3.85	3.15	1.12	0.14	18.2	3.89	0.51	12.7	6.41	0.69	0.08	0.48	0.07

#	Sensitive Receptor	Location (UTM NAD83)			$SO_{2\ agl}$				$SO_{2\ at\ 15m}$				NO_2			CO		PM_{10}		$PM_{2.5}$	
					µg/m^3				µg/m^3				µg/m^3			µg/m^3		µg/m^3		µg/m^3	
		Zone	mE	mN	1-hour	3-hour	24-hour	Annual	1-hour	3-hour	24-hour	Annual	1-hour	24-hour	Annual	1-hour	8-hour	24-hour	Annual	24-hour	Annual
34	Digby Island - Dodge Cove	9	409883	6016045	14.4	10.3	3.70	0.43	14.4	10.7	3.81	0.42	179	32.9	2.23	160	58.1	2.37	0.31	2.27	0.24
35	ICEC Terminals	9	413506	6009025	24.5	19.6	6.92	0.84	22.4	18.6	6.81	0.86	62.3	14.1	1.75	29.1	13.9	13.3	1.45	8.21	0.91
36	Port Edward - Commercial	9	416780	6006922	14.4	10.8	2.01	0.21	14.4	10.8	2.03	0.22	60.0	13.9	0.83	114	33.5	4.36	0.33	2.63	0.22
37	Cannery Museum and Village	9	420099	6005868	4.07	2.56	0.91	0.10	4.08	2.57	0.91	0.10	27.4	6.29	0.37	51.4	12.5	2.30	0.15	2.16	0.11
38	Old Cannery	9	423153	6003964	2.42	1.80	0.60	0.066	2.42	1.80	0.60	0.067	15.7	3.11	0.26	29.0	7.72	1.78	0.10	1.68	0.08
39	Metlakatla Sandbar	9	404285	6021789	4.72	4.25	1.33	0.12	4.69	4.24	1.33	0.12	14.7	4.86	0.43	11.8	5.01	0.54	0.07	0.46	0.06
40	West-side Kaien Island	9	413901	6009149	18.9	13.2	4.60	0.67	24.0	12.7	4.59	0.70	68.1	10.1	1.81	30.9	17.3	11.8	1.60	6.90	0.96
41	Sand Bar North of Casey Point	9	411825	6013986	11.0	7.67	3.55	0.41	11.1	8.18	3.57	0.41	86.2	20.3	1.80	79.2	41.3	3.30	0.41	1.95	0.29
42	North End of Porcher Island	9	406964	5994583	3.52	1.54	0.62	0.022	4.04	1.77	0.62	0.024	15.0	2.96	0.07	9.42	2.44	0.92	0.03	0.84	0.02
43	Ridley Island	9	413919	6008375	14.6	11.6	4.76	0.55	14.3	11.1	4.77	0.57	41.8	9.74	1.61	37.4	17.0	8.09	0.81	4.58	0.51
44	Sand Bar North of Casey Point	9	411825	6013986	11.0	7.67	3.55	0.41	11.1	8.18	3.57	0.41	86.2	20.3	1.80	79.2	41.3	3.30	0.41	1.95	0.29
45	Pike Island	9	405106	6020457	6.69	4.71	1.42	0.13	6.62	4.66	1.41	0.13	17.5	4.96	0.50	15.4	6.52	0.62	0.08	0.50	0.06
46	Alwyn Lake	9	419405	6008531	5.05	3.00	1.08	0.14	5.06	3.40	1.08	0.14	41.6	11.0	0.66	37.1	20.1	2.26	0.22	1.72	0.16
47	Woodworth Lake	9	424060	6022558	2.22	1.96	0.46	0.045	2.21	1.96	0.46	0.045	11.1	2.35	0.21	13.9	3.77	1.26	0.05	1.19	0.04
48	Shawatlans Lake	9	419531	6021359	3.95	3.16	1.16	0.080	3.97	3.19	1.17	0.080	11.6	3.60	0.33	13.9	5.81	1.36	0.08	1.26	0.07

Table 8-4: Maximum Predicted Concentrations at Specified Sensitive Receptors for the Cumulative Effects Assessment Case

#	Sensitive Receptor	Location (UTM NAD83)			$SO_{2\ agl}$				$SO_{2\ at\ 15m}$				NO_2			CO		PM_{10}		$PM_{2.5}$	
					µg/m^3				µg/m^3				µg/m^3			µg/m^3		µg/m^3		µg/m^3	
		Zone	mE	mN	1-hour	3-hour	24-hour	Annual	1-hour	3-hour	24-hour	Annual	1-hour	24-hour	Annual	1-hour	8-hour	24-hour	Annual	24-hour	Annual
1	Charles Hays Secondary	9	415148	6018920	29.4	20.7	5.25	0.64	29.6	20.7	5.27	0.64	61.6	11.8	1.78	31.6	12.3	2.03	0.23	1.91	0.20
2	Conrad Elementary School	9	415497	6019977	29.3	18.2	5.15	0.52	29.6	19.1	5.27	0.52	39.7	11.9	1.56	29.3	11.7	2.20	0.21	2.05	0.18
3	Lax Kxeen Elementary	9	414833	6019688	31.8	21.0	7.38	0.70	32.1	22.6	7.58	0.70	45.0	12.6	1.87	30.0	14.4	2.18	0.22	2.06	0.20
4	Hartley Bay Elementary Junior School	9	414701	6019593	33.9	23.3	8.54	0.80	34.1	25.0	8.75	0.81	47.6	13.9	2.01	31.4	14.8	2.24	0.23	2.11	0.20
5	Pacific Coast School	9	413750	6019199	33.3	21.2	7.96	0.72	33.4	22.9	8.20	0.74	61.2	18.7	2.27	54.5	24.0	2.43	0.26	2.28	0.23
6	Pineridge Elementary	9	413072	6017569	50.7	37.1	9.66	1.19	56.8	36.8	10.34	1.20	133	21.3	3.15	112	32.5	2.74	0.33	2.51	0.28
7	Port Edward Community School	9	416000	6008813	23.7	11.9	4.93	0.75	23.8	11.8	4.91	0.76	79.0	18.6	2.76	87.0	28.1	9.47	0.76	5.89	0.52
8	Prince Rupert Middle School	9	414271	6018650	28.8	20.5	5.61	0.70	29.3	20.5	5.90	0.70	50.9	12.8	2.00	37.4	13.4	2.12	0.24	1.95	0.21
9	Roosevelt Park Elementary (same as 5)	9	413671	6018447	55.2	43.8	10.5	0.86	55.4	48.4	11.1	0.88	83.3	17.9	2.50	74.3	19.5	2.40	0.28	2.22	0.24
10	First Nations Education	9	414323	6018829	30.1	20.9	5.89	0.73	30.7	20.8	6.18	0.74	45.4	13.1	2.02	37.7	13.6	2.06	0.24	1.96	0.21
11	Discovery Child Care	9	415307	6018937	32.2	21.5	5.40	0.61	32.0	21.5	5.40	0.62	64.3	11.8	1.74	33.0	11.9	2.10	0.23	1.97	0.20
12	Berry Patch Child Care	9	413806	6019276	32.3	20.5	7.64	0.68	32.3	21.6	7.85	0.69	60.9	18.1	2.21	51.0	24.0	2.42	0.25	2.26	0.22
13	Fellowship Baptist Nursery School	9	414793	6019593	32.1	20.4	7.81	0.73	32.4	22.1	8.01	0.74	44.4	13.0	1.91	29.8	13.9	2.19	0.23	2.07	0.20
14	KIDS Daycare	9	415573	6020077	28.6	17.3	4.90	0.50	29.0	18.2	5.01	0.50	39.4	11.8	1.52	29.8	11.8	2.21	0.20	2.06	0.18
15	Westview Child Care Centre	9	413671	6018447	55.2	43.8	10.5	0.86	55.4	48.4	11.1	0.88	83.3	17.9	2.50	74.3	19.5	2.40	0.28	2.22	0.24
16	Kaien Senior Citizen Housing	9	414576	6019595	34.5	25.5	9.25	0.90	34.7	27.3	9.49	0.91	50.0	14.9	2.14	33.3	16.2	2.27	0.24	2.14	0.21
17	Prince Rupert Regional Hospital	9	413374	6018191	57.2	41.1	10.5	0.96	57.6	46.8	11.2	0.98	107	18.7	2.73	97.9	25.1	2.51	0.30	2.29	0.26
18	Port Edward -residence	9	415968	6008506	26.8	13.1	4.61	0.71	27.0	13.2	4.61	0.72	89.3	18.1	2.68	94.2	36.9	9.29	0.72	5.77	0.50
19	Port Edward - residence	9	416039	6008371	25.4	12.7	4.50	0.71	25.5	12.8	4.49	0.72	91.8	17.2	2.67	98.7	38.7	8.99	0.71	5.59	0.49
20	Port Edward - residence	9	416092	6007960	18.4	10.8	4.39	0.71	18.5	11.0	4.40	0.72	87.0	16.3	2.74	96.1	31.5	8.60	0.68	5.34	0.48
21	Kitson Island campsite	9	414285	6004189	19.1	14.2	4.73	0.29	20.0	15.2	4.94	0.30	120	31.1	0.99	24.6	11.0	3.62	0.19	3.20	0.13
22	Kinahan Islands 1	9	408530	6008181	17.0	10.2	4.08	0.23	17.0	10.2	4.09	0.24	33.0	12.1	0.90	77.1	16.3	2.08	0.18	1.93	0.12
23	Rachael Islands	9	398370	6008130	11.9	8.90	2.49	0.15	11.8	8.82	2.51	0.16	49.6	17.8	0.67	35.7	18.8	1.48	0.11	1.46	0.083
24	Lucy Islands	9	394920	6017521	15.0	6.50	2.41	0.18	14.9	6.57	2.40	0.18	23.4	6.93	0.46	20.8	8.99	1.18	0.07	0.98	0.054
25	Digby Island	9	409847	6010580	23.9	15.1	6.08	0.39	23.9	15.0	6.06	0.41	57.0	16.1	1.45	43.6	18.8	4.22	0.51	2.59	0.32
26	Smith Island	9	417967	6005696	12.3	8.38	3.43	0.41	12.4	8.38	3.43	0.41	57.5	16.8	1.32	54.0	31.2	4.35	0.34	4.10	0.26
27	Kinahan Islands 2	9	408272	6006828	14.2	8.46	3.14	0.16	14.2	8.45	3.17	0.16	32.0	12.8	0.85	56.0	13.3	2.10	0.13	2.02	0.10
28	Rachael Islands 2	9	398403	6006533	7.79	6.64	2.11	0.10	7.81	6.62	2.14	0.10	57.8	10.0	0.52	41.5	11.7	1.54	0.075	1.52	0.060
29	Porcher Island Northwest	9	398298	5989431	6.86	3.39	0.64	0.03	6.94	3.43	0.65	0.03	15.2	2.09	0.08	8.0	2.02	0.67	0.021	0.66	0.017
30	Porcher Island - Hunts Inlet	9	405553	5992085	7.13	3.81	1.27	0.04	7.16	3.84	1.27	0.04	15.9	6.42	0.13	12.5	5.68	1.60	0.035	1.55	0.029
31	Porcher Island North	9	408871	5994124	6.10	4.17	0.93	0.05	6.08	4.23	0.94	0.05	21.2	3.81	0.14	13.9	3.53	2.30	0.045	2.19	0.035
32	Osland Village	9	424115	5999346	5.95	4.32	1.58	0.14	5.95	4.31	1.58	0.14	32.0	9.61	0.58	54.6	13.6	2.24	0.13	2.17	0.11
33	Metlakatla First Nations	9	405967	6021882	20.9	14.5	5.42	0.49	21.0	14.4	5.38	0.49	48.7	12.2	1.29	19.5	11.9	1.08	0.13	1.04	0.11

#	Sensitive Receptor	Location (UTM NAD83)			$SO_{2\ agl}$ µg/m³				$SO_{2\ at\ 15m}$ µg/m³				NO_2 µg/m³			CO µg/m³		PM_{10} µg/m³		$PM_{2.5}$ µg/m³	
		Zone	mE	mN	1-hour	3-hour	24-hour	Annual	1-hour	3-hour	24-hour	Annual	1-hour	24-hour	Annual	1-hour	8-hour	24-hour	Annual	24-hour	Annual
34	Digby Island - Dodge Cove	9	409883	6016045	74.0	47.2	17.3	1.89	68.2	46.4	18.4	1.98	230	63.6	5.44	207	82.6	3.96	0.49	3.85	0.40
35	ICEC Terminals	9	413506	6009025	34.2	26.2	8.62	1.43	32.1	25.0	8.92	1.50	125	36.1	4.96	73.2	28.3	13.38	1.81	8.31	1.20
36	Port Edward - Commercial	9	416780	6006922	16.6	11.6	3.88	0.52	16.6	11.6	3.89	0.53	80.4	17.5	1.82	115	37.5	5.62	0.44	4.85	0.33
37	Cannery Museum and Village	9	420099	6005868	8.68	5.91	2.18	0.26	8.71	5.92	2.18	0.26	52.1	11.5	0.89	83.4	19.9	4.55	0.22	4.40	0.18
38	Old Cannery	9	423153	6003964	6.36	4.31	1.71	0.18	6.37	4.32	1.71	0.18	28.5	8.15	0.61	44.6	14.0	3.67	0.16	3.57	0.13
39	Metlakatla Sandbar	9	404285	6021789	22.6	13.4	4.70	0.38	22.6	13.6	4.68	0.38	36.0	13.1	1.05	18.4	9.48	1.04	0.11	1.00	0.10
40	West-side Kaien Island	9	413901	6009149	30.5	24.5	9.54	1.40	30.2	25.2	9.58	1.44	110	22.7	6.06	86.7	33.1	13.37	2.02	8.34	1.31
41	Sand Bar North of Casey Point	9	411825	6013986	97.7	60.1	31.1	2.06	97.2	60.8	32.4	2.09	239	61.3	6.19	176	94.0	4.00	0.65	3.75	0.51
42	North End of Porcher Island	9	406964	5994583	8.36	4.72	2.09	0.06	9.21	4.78	2.09	0.07	30.0	7.40	0.17	15.9	5.22	2.10	0.050	2.02	0.04
43	Ridley Island	9	413919	6008375	25.5	20.6	8.80	1.06	25.2	20.2	8.83	1.10	92.6	20.6	4.47	186	36.3	9.30	1.17	6.07	0.78
44	Sand Bar North of Casey Point	9	411825	6013986	97.7	60.1	31.1	2.06	97.2	60.8	32.4	2.09	239	61.3	6.19	176	94.0	4.00	0.65	3.75	0.51
45	Pike Island	9	405106	6020457	29.0	16.5	4.14	0.41	29.1	16.6	4.15	0.41	43.1	12.8	1.17	24.7	12.1	1.16	0.13	1.12	0.11
46	Alwyn Lake	9	419405	6008531	13.3	9.36	2.86	0.34	13.2	9.29	2.86	0.34	47.6	12.9	1.36	78.3	27.0	4.35	0.31	4.13	0.24
47	Woodworth Lake	9	424060	6022558	7.77	4.97	1.29	0.12	7.79	4.96	1.29	0.12	21.5	4.88	0.47	27.0	7.77	2.65	0.091	2.58	0.084
48	Shawatlans Lake	9	419531	6021359	10.9	7.48	2.16	0.21	11.1	7.54	2.17	0.21	23.8	7.27	0.75	30.7	13.5	2.79	0.14	2.68	0.12