ALAMOS GOLD INC.

Lynn Lake Gold Project
Environmental Impact Statement

Federal IR Responses
Round 1, Package 2

Stantec

Prepared by:

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June 1, 2021

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INTRODUCTION

The Impact Assessment Agency of Canada (the Agency) provided the second package of the first round (Round 1, Package 2) of Information Requests (IRs) on December 22, 2020, for the Lynn Like Gold Project Environmental Impact Statement (EIS) submitted by Alamos Gold Inc. (Alamos) on May 25, 2020. Upon review of the EIS, the Agency, federal authorities, and Indigenous Nations identified areas where additional information would be required. The Agency directed that this additional information is necessary to determine whether the Project is likely to cause significant adverse environmental effects and to inform the Agency's preparation of the Environmental Assessment (EA) Report under the *Canadian Environmental Assessment Act, 2012* (CEAA 2012).

Alamos confirms that each of the 89 IRs provided in Round 1, Package 2 have been fully addressed and answered as clearly and succinctly as possible. A fulsome response to each IR is provided in the following sections in reference to the original request. Where required to complete the response, attachments have been provided in Appendix A.

Alamos has followed the Agency's direction and has considered the following while responding to the Information Requests:

- The context and rationale for the required information for every question.
- Applied a precautionary approach, given that some studies and plans may not be complete at this time.
- Provided additional information (wherever possible) to assuage uncertainty and to provide clearly defined, detailed follow-up program measures, including proposed further mitigation measures.
- Presented complete or summarized information and discussion within the information request responses, rather than limited responses to references to applicable reports.

On May 11, 2021, a supplemental filing was submitted to the Agency regarding the MacLellan site Water Balance/Water Quality Model Update Following Mine Rock Storage Area (MRSA) Refinement. As documented in this filing, Alamos has redesigned the MRSA at the MacLellan site, which has resulted in a reduction in the Project Development Area (PDA) at the MacLellan site. This change in PDA has been incorporated into the Round 1, Package 2 IR responses. No changes to the local assessment area for any VCs has been proposed from what was presented in the EIS.

An updated assessment of the effects of the Project on the groundwater, surface water, and fish and fish habitat valued components (VCs) at the MacLellan site was presented in the supplemental filing. No changes to the determination of significance of effects of the Project or cumulative effects of these VC were identified. No change to the conclusions of the EIS or the assessment of other VCs assessed in the EIS has been identified.

Alamos is committed to discussing and resolving any further information requests throughout the review process.

RESPONSE TO IAAC-56

ID:	**IAAC-56**
Expert Department or Group:	NRCan-01
Guideline Reference	3.2.3 Spatial and temporal boundaries
EIS Reference	8.1.4.1 Spatial Boundaries Map 8-2
Information Request:	a. Provide a rationale for the location of the southern boundary of the MacLellan site LAA/RAA, including a description or explanation of why the boundary does not follow surface water divides, and describe any portions of tributaries that were excluded. b. Describe the potential effect of the location of the LAA/RAA on the assessment of changes to groundwater-surface water interactions in tributaries that were bisected or excluded.
Response:	a. The spatial boundaries of the local assessment area (LAA)/regional assessment area (RAA) for the MacLellan site correspond with the groundwater flow model boundaries. Where practical, the boundaries were defined to coincide with natural hydrologic and hydrogeologic boundaries such as watershed boundaries and surface water bodies. The boundaries were also chosen to encompass the likely extent of drawdown from open pit dewatering and changes to groundwater flow or quality due to recharge from the tailings management facility (TMF) and mine rock storage area (MRSA) as well as an understanding of potential cumulative effects with other projects or activities. The southern boundary of the LAA/RAA for the MacLellan site follows the northern shore of Cockeram Lake before turning northwest toward the northern shore of Eldon Lake and eastern shore of Burge Lake. The portion of the boundary that extends from Cockeram Lake to Burge Lake did not follow the natural hydrologic or hydrogeologic boundary to limit the extent of the groundwater flow model. The southern boundary was chosen as a sufficient distance from the open pit development to limit potential for boundary effects while encompassing the effects of the Project. b. Tributaries that were bisected or excluded by the southern boundary of the groundwater LAA/RAA and groundwater flow model boundary are associated with the southern extent of the Keewatin River, prior to discharging to Cockeram Lake. These tributaries are located south of the Keewatin River and Lynn River, which represent natural hydrologic and hydrogeologic boundaries for shallow groundwater. The groundwater flow model predictions suggest no effect of the Project on these southern tributaries of the Keewatin River and therefore the effect of the tributary being bisected by the groundwater flow model boundary is not material. The groundwater LAA/RAA and groundwater flow model boundary encompass the effects of the Project on groundwater and therefore the model boundaries are deemed sufficient for the purpose of the environmental assessment.
Attachment:	No

RESPONSE TO IAAC-57

ID:	**IAAC-57**
Expert Department or Group:	MCCN-21 NRCan-02
Guideline Reference	3.2.3 Spatial and temporal boundaries
EIS Reference	8.1.4 Boundaries Volume 5, Appendix F Lynn Lake Gold Project, Hydrogeology Assessment – Gordon site Technical Modelling Report 5.4.1 Model Setup Appendix G Lynn Lake Gold Project, Hydrogeology Assessment – MacLellan site Technical Modelling Report 5.4.1 Model Setup
Information Request:	a. Considering the response to Round 1 Package 1, IAAC-38, clarify the time periods and conditions assessed for the decommissioning and closure phases of the Project with respect to groundwater quantity. Align these time periods with the results presented in the hydrogeological technical assessments in EIS Volume 5, Appendices F and G. b. Provide an evidence-based time frame over which the stability of the site (e.g., groundwater quality in reference to regulatory criteria) is assessed to determine when to cease monitoring.
Response:	a. Groundwater quantity is predominantly affected by open pit dewatering. For groundwater quantity, the ultimate extent of open pit dewatering was evaluated as part of the operational phase of the Project followed by the effect of the ultimate pit lakes that was evaluated as part of the post-closure phase of the Project. These two scenarios represent the end points of worst case effect of dewatering (operation) and the ultimate long-term effect of the Project (post-closure) on groundwater. For the Gordon site, pit filling is predicted to take 11 years. Therefore the results presented in the hydrogeological technical assessment in the Environmental Impact Statement (EIS; Volume 1, Chapter 8 and Volume 5, Appendix F) represent the post-closure phase, 11 years into closure when the pit lake is full. For the MacLellan site, pit filling is predicted to take 21 years. Therefore, the results presented in the hydrogeological technical assessment in the EIS (Volume 1, Chapter 8 and Volume 5, Appendix G) represent the post-closure phase, 21 years into closure when the pit lake is full. b. Groundwater monitoring will continue during pit filling (i.e., for 11 years at the Gordon site and 21 years at the MacLellan site). Groundwater quantity and quality is expected to stabilize during post-closure once the open pits have filled. Groundwater monitoring will continue at both sites for 6 years (estimated) post pit filling. The locations and frequency of monitoring in closure will be determined through the results of monitoring and adaptive management that occurs during operation. Volume 1, Chapter 8, Section 8.9 of the EIS provides information on groundwater monitoring, and Volume 3, Chapter 23 of the EIS provides information on the environmental monitoring and management plans as well as presents the Conceptual Closure Plan for the Project. Monitoring will be completed throughout the life of the Project and into closure until the sites are restored to satisfactory

ID:	**IAAC-57**
	condition in accordance with federal and/or provincial legislation and guidelines. The water balance and quality model (see Volume 5, Appendices D and E of the EIS and the May 11, 2021 supplemental filing) was used to predict the evolution of seepage quality over time. This data will be used along with monitoring through the life of mine to inform and confirm predictions of seepage quality for closure. Monitoring will continue until physical stability of water chemistry below the criteria for discharge to the environment can be validated. A conceptual Closure Plan was provided within the EIS (Volume 3, Appendix 23B). A detailed Closure Plan will be developed that conforms with *The Mines and Minerals Act Mine Closure Regulation* and will describe specific closure criteria. This more detailed Closure Plan will be developed during the permitting stage of Project planning (i.e., following receipt of a federal Decision Statement for the Project under CEAA 2012 and provincial licences for the Project under *The Environment Act* of Manitoba) and will be completed prior to the start of Project construction.
Attachment:	No

RESPONSE TO IAAC-58

ID:	**IAAC-58**
Expert Department or Group:	NRCan-03
Guideline Reference	4.3 Study strategy and methodology
EIS Reference	8.2.1.2 Hydrogeological Model Volume 5, Appendix F Lynn Lake Gold Project, Hydrogeology Assessment – Gordon site Technical Modelling Report Table 4-1 Appendix G Lynn Lake Gold Project, Hydrogeology Assessment – MacLellan site Technical Modelling Report Table 4-1
Information Request:	a. Provide a rationale for the selection of the location of the lower model boundary. b. Indicate the anticipated impact of the lower model boundary location on the assessment of groundwater quantity.
Response:	a. The lower boundary of the groundwater flow model for the MacLellan and Gordon sites was chosen as the base of the open pits, which corresponded to an elevation of 115 m above mean sea level (amsl) at the Gordon site and -50 m amsl at the MacLellan site. Given the depth of bedrock and the low hydraulic conductivity additional flow beyond the model boundary depth is not anticipated to be significant. b. The measured hydraulic conductivity of the bedrock layers within the groundwater flow model varies over three orders of magnitude at the Gordon site and two orders of magnitude at the MacLellan site. This results in the groundwater flow occurring predominantly in the overburden and shallower bedrock layers (i.e., the upper model layers). In addition, the groundwater receptors (surface water features, potential for groundwater users) are limited to the overburden and shallow bedrock, upper model layers. Therefore the potential effect of the lower model boundary on the assessment of groundwater quantity is limited.
Attachment:	No

RESPONSE TO IAAC-59

ID:	**IAAC-59**
Expert Department or Group:	NRCan-04
Guideline Reference	6.1.2 Geology and geochemistry
EIS Reference	8.2.2.1 Local Geology and Hydrostratigraphy
Information Request:	a. Clarify the maximum depth to bedrock found through drilling at the MacLellan site.
Response:	a. At the MacLellan site, bedrock was encountered at 65 boreholes completed as part of environmental baseline studies and 1,341 boreholes completed as part of exploration and condemnation drilling. Bedrock was generally encountered at depths up to 10 m except in a few locations where the potential for bedrock depressions and/or valleys were noted as documented in Volume 1, Chapter 8, Section 8.2.2.1 of the Environmental Impact Statement (EIS). The data suggests that there is a bedrock valley in the vicinity of Minton Lake where boreholes were terminated at 28 m below ground surface prior to encountering bedrock. As noted in the Hydrogeology Baseline Technical Validation Report (Volume 4, Appendix H of the EIS) and the MacLellan site Hydrogeology Assessment Technical Modelling Report (Volume 5, Appendix G of the EIS), the hydraulic conductivity of the predominant overburden units and shallow bedrock is the same order of magnitude and therefore the uncertainty in the top of bedrock is not anticipated to have an effect on the assessment of effects of the Project on groundwater.
Attachment:	No

RESPONSE TO IAAC-60

ID:	**IAAC-60**
Expert Department or Group:	NRCan-05
Guideline Reference	6.1.2 Geology and geochemistry
EIS Reference	8.2.2.1 Local Geology and Hydrostratigraphy Map 8-12
Information Request:	a. Review and confirm the location of the East Fault termination in relation to Wendy pit. i. If the conclusion in the EIS is confirmed, provide the rationale used to terminate the East Fault to the east of the Wendy pit. ii. If it is determined that the East Fault does not terminate to the east of Wendy pit, update the groundwater assessment using the revised termination location of the East Fault zone.
Response:	a. i. and ii. In the groundwater flow model for the Gordon site, the East Fault was not terminated at the Wendy Pit but rather extends under Gordon Lake. Please see response to IAAC-65 for a detailed description of the East and Wendy faults as well as how the faults were characterized within the Gordon site groundwater flow model, including a presentation of the spatial extent.
Attachment:	No

RESPONSE TO IAAC-61

ID:	**IAAC-61**
Expert Department or Group:	NRCan-06
Guideline Reference	6.1.2 Geology and geochemistry
EIS Reference	8.2.2.1 Local Geology and Hydrostratigraphy Map 8-13 Volume 4, Appendix H Hydrogeology Baseline Technical Data Report 4.2.2.1 Geology and Hydrostratigraphy
Information Request:	a. Provide maps showing the variation in overburden thickness across the LAA for both the Gordon and MacLellan sites. b. Review and confirm whether the low to the north of Minton Lake and the low to the east of the pit are separated (distinct from one another). Describe whether the low associated with the fault zone is presumed to be due to increased propensity to erosion within the faulted zone, or due to displacement associated with the faulting. i. If it is concluded that the two lows are distinct, provide rationale for the separation of the two bedrock lows to the east of the MacLellan pit. ii. If it is determined that there is additional connectivity between the bedrock low to the north of Minton Lake and the low to the east of the pit than what was used in the EIS, update the groundwater assessment using the revised information.
Response:	a. Maps IAAC-61-1 and IAAC-61-2, attached with the response to these comments, show the variation in modelled overburden thickness across the local assessment area (LAA) for both the Gordon and MacLellan sites. The interpolated overburden thickness is based on exploration borehole, environmental monitoring well, and geotechnical drilling data. Where no data was available an assumption of 1 m depth to bedrock was applied throughout the remainder of the groundwater flow model domain, as stated in Volume 5, Appendices F and G of the Environmental Impact Statement (EIS). Please refer to response to b. below for additional comment on the relevance of overburden thickness on the prediciton of Project effects to groundwater. b. i. and ii. The geology of the MacLellan site is detailed in the NI-43-101 Technical Report Feasibility Study for the Lynn Lake Gold Project (Ausenco 2019). The North Shear Zone (NSZ) is an area where the rock is folded into a steep upright syncline that dips steeply to the north and plunges moderately steeply towards the southwest. This intense deformation has resulted in brittle fracturing associated with fold closures. It does not appear to affect the top of bedrock surface. Based on available borehole data and the interpreted top of bedrock (Map 13 in Volume 4, Appendix F of the EIS), the bedrock low extends from the open pit to Minton Lake but was not interpreted to have a consistent depth throughout the bedrock low. Further data collection west of Minton Lake has been limited due to access issues resulting from the presence of wetland features (bog and fen). Regardless of the topography of the top of bedrock, the calibrated hydraulic conductivity of the glaciolacustrine, diamicton, and shallow bedrock in the groundwater flow model is the same order of magnitude (10^{-6} m/s). Therefore, the

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	overburden and shallow bedrock within the areas of the bedrock low would be hydraulically connected and would have little effect on the conclusions of the assessment of the effects of the Project on groundwater. Therefore, reassessment of the effects of the Project on groundwater is not required. **Reference:** Ausenco. 2019. NI 43-101 Technical Report Feasibility Study for the Lynn Lake Gold Project, Manitoba Canada (Update Study; Draft; Revision D). Prepared for Alamos Gold Inc. by Ausenco Engineering Canada Inc. Toronto, Ontario.
Attachment:	Appendix A, Attachment IAAC-61

RESPONSE TO IAAC-62

ID:	**IAAC-62**
Expert Department or Group:	NRCan-07
Guideline Reference	6.1.5 Groundwater and Surface Water
EIS Reference	8.2.2.3 Estimation of Hydraulic Conductivity Figure 8-1 Volume 4, Appendix H 4.2.1.3 Hydraulic Conductivity 4.2.2.3 Hydraulic Conductivity, Volume 5, Appendix F Lynn Lake Gold Project, Hydrogeology Assessment – Gordon site Technical Modelling Report, 3.3.5 Bedrock, Appendix G Lynn Lake Gold Project, Hydrogeology Assessment – MacLellan site Technical Modelling Report, 3.3.5 Bedrock
Information Request:	a. In figures showing the relationship between depth below the top of bedrock and hydraulic conductivity, indicate which tests are completed in which bedrock zone (shallow, upper, intermediate, or deep). b. Provide the rationale for the depth selection for each bedrock subdivision. c. Describe the lack of testing of the deep bedrock zone at the Gordon site and the potential impact on model results. d. Describe the results of testing at the MacLellan site in the intermediate and deep bedrock, and the evidence for a reduction in hydraulic conductivity with depth. e. Describe any gaps in information and related uncertainty with regards to the assessment of effects to groundwater. Describe any additional mitigation measures and/or monitoring and follow-up, including adaptive management that would be implemented.
Response:	a. Figure 8-1 in Chapter 8 of the Environmental Impact Statement (EIS) (Volume 1) presents the hydraulic conductivity with depth below top of bedrock. The graph presents the length of the bedrock interval tested as well as the type of hydraulic test completed, whether it was a packer test, pumping test, or slug test. Within the groundwater flow models for the Gordon and MacLellan sites, the bedrock was divided into shallow, upper, intermediate, and deep bedrock. Figure 8-1 was updated to reflect the division of bedrock in the model layers compared to hydraulic conductivity with depth, and is presented as attachment, Figure IAAC-62-1, to this response, with the following description: At the Gordon site, shallow bedrock was defined as the upper 50 m of bedrock. Three packer tests and 55 slug tests were completed within the shallow bedrock. Based on the results of the packer testing, which indicated relatively higher hydraulic conductivity of bedrock compared to the MacLellan site, and historical interactions of the historical open pits and Gordon and Farley lakes, two pumping tests were also completed at the Gordon site to estimate hydraulic conductivity of bedrock. The upper bedrock was defined as the 50 to 100 m depth of bedrock. Three packer tests and one pumping test were completed within the upper bedrock. The intermediate bedrock was defined as the 100 to 150 m depth of bedrock. Two packer tests were completed within the intermediate bedrock. The deep bedrock was defined as greater than 150 m depth below bedrock with a unit thickness of 33 m. There was no hydraulic testing data available for the deep bedrock.

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	At the MacLellan site, shallow bedrock was defined as the upper 10 m of bedrock. Nine packer tests and 48 slug tests were completed within the shallow bedrock. The upper bedrock was defined as the 10 to 50 m depth of bedrock. Thirteen packer tests were completed within the upper bedrock. The intermediate bedrock was defined as the 50 to 200 m depth of bedrock. Twenty-one packer tests were completed within the intermediate bedrock. The deep bedrock was defined as greater than 200 m depth of bedrock with a unit thickness of 150 m. Six packer tests were completed within the deep bedrock. b. The division of bedrock into four zones (shallow, upper, intermediate, and deep bedrock) is based on the available hydraulic conductivity data and the maximum depth of the open pits. The difference in delineating the bedrock model layers between the two sites is based on site-specific data. At the Gordon site, the hydraulic testing data suggested the hydraulic conductivity was more variable over a thicker portion of the shallow bedrock and therefore the shallow bedrock unit was defined as 50 m thick compared to at the MacLellan site where the shallow bedrock was defined as 10 m. The remaining bedrock units were generally delineated at set intervals to the base of the open pits to capture the decrease in hydraulic conductivity with depth. Delineating the model into four bedrock units allows the hydraulic conductivity of the bedrock to vary during the model calibration process to determine the best hydraulic conductivity to fit the observed to the predicted calibration targets. The calibration process is described in Sections 4.4.1 of the Gordon and MacLellan Hydrogeology Technical Modelling Reports (Volume 5, Appendices F and G, respectively). c. Hydraulic conductivity testing was completed up to 130 m below the top of bedrock at the Gordon site while the open pit will extend about 75 m deeper (ultimate depth of the open pit is 225 m below ground surface). The deep bedrock was assigned a range of hydraulic conductivity of $4x10^{-8}$ to $6x10^{-7}$ m/s in the groundwater flow model. During the calibration process the hydraulic conductivity was allowed to vary within this range until a good match of model parameter values to field measured values was obtained. The resulting calibrated hydraulic conductivity value for the deep bedrock was $5x10^{-8}$ m/s. The groundwater flow model predictions of open pit dewatering suggest the majority of flow into the open pit is through the shallow bedrock and the faulted shallow bedrock zone and not from deep bedrock. To address uncertainty in the hydraulic conductivity of bedrock, a sensitivity analysis of the model predictions to bedrock hydraulic conductivity was completed and is presented in Section 5.3.2.2 of the Hydrogeology Technical Modelling Report for the Gordon site (Volume 5, Appendix F). As the majority of flow into the open pit was from the shallow bedrock layers, the sensitivity analysis involved increasing and decreasing the hydraulic conductivity of the shallow bedrock and faulted shallow bedrock compared to the calibrated hydraulic conductivity for the given unit. The results of the sensitivity analysis indicates varying the hydraulic conductivity of the shallow bedrock by two orders of magnitude resulted in less than a 30% change in the total estimated dewatering required for the open pit and interceptor wells. However, varying the faulted bedrock hydraulic conductivity by the same range resulted in much larger changes and that varying the shallow bedrock and faulted bedrock zone by an order of magnitude would have a detrimental effect on the calibration of the model. Therefore, the hydraulic conductivity values determined during the calibration of the model are considered representative and were carried forward in the analysis of effects of the Project on

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groundwater. The results of the sensitivity analysis with the groundwater flow model was consistent with the field testing data, which included a pumping test as well as detailed packer testing that indicated the field estimates of hydraulic conductivity were consistent with the range of hydraulic conductivity estimates in which the groundwater flow model was stable and calibrated.

d. At the MacLellan site, the hydraulic conductivity of the bedrock decreases with depth, with the upper portions being the most transmissive due to increased weathering and/or fracturing. The hydraulic conductivity data for bedrock varies over six orders of magnitude. With respect to the intermediate and deep bedrock units, the variation in hydraulic conductivity with depth is less, varying over three orders of magnitude.

   Based on field testing, the hydraulic conductivity of intermediate bedrock ranged from $3x10^{-9}$ m/s to $6x10^{-7}$ m/s. The deep bedrock ranged from $9x10^{-9}$ m/s to $6x10^{-8}$ m/s. This range of hydraulic conductivity was assigned to the groundwater flow model layers for intermediate and deep bedrock. The model calibration process was completed iteratively, where parameters such as hydraulic conductivity were allowed to vary within a set range until a good match with field-measured values were achieved within a pre-established range of error (see Section 4.4.1 of the Hydrogeology Assessment - MacLellan site, Technical Modelling Report, Volume 5, Appendix G of the EIS). The calibrated groundwater flow model for the MacLellan site resulted in an assigned hydraulic conductivity of $3.4x10^{-8}$ m/s and $1.3x10^{-8}$ m/s for the intermediate and deep bedrock, respectively. The results of the field testing (Figure IAAC-62-1 attached) and the model calibration process suggest that hydraulic conductivity between the intermediate and deep bedrock units varies less than between the shallower bedrock layers (shallow bedrock and upper bedrock) and the deeper bedrock layers (intermediate bedrock and deep bedrock). These results were reflected in the assessment of effects of the Project on groundwater in the EIS.

   A sensitivity analysis was completed to address potential uncertainty of hydraulic conductivity of the bedrock. As the majority of flow into the open pit is predicted to occur from the shallow bedrock, the hydraulic conductivity of the shallow bedrock was varied. Decreasing the hydraulic conductivity of the shallow bedrock by an order of magnitude resulted in a 30% change in the predicted dewatering rate of the open pit. Increasing the hydraulic conductivity of the shallow bedrock by an order of magnitude resulted in detrimental effects to the model calibration. Therefore, the hydraulic conductivity values determined during the calibration of the model are considered representative and were carried forward in the analysis of effects of the Project on groundwater.

e. The response to c. and d. provide a summary of the gaps and uncertainty in relation to hydraulic conductivity of the groundwater flow model layers as well as how the gaps and uncertainty were addressed in the assessment of effects of the Project on groundwater. The gaps and uncertainty were addressed through field testing (single well testing, packer testing, and pumping tests) and an iterative calibration process that allows the hydraulic conductivity of a model layer to vary between a defined range of values until a good match of predicted and observed model calibration parameters are observed. In addition, sensitivity analysis was completed to evaluate potential changes in hydraulic conductivity from the calibrated model parameters. The mitigation measures and follow up monitoring are presented in Volume 1, Chapter 8, Sections 8.4 and 8.9, as well as Volume 3, Chapters 20 and 23, respectively of the EIS, and are sufficient to confirm the

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	current assessment of effects to groundwater and no further modifications to the program are required at this time. Follow up monitoring will be undertaken as the mine development proceeds. With respect to groundwater, follow up monitoring will include groundwater quantity (level, pumped volumes) and quality (general chemistry and select dissolved metals) monitoring with an adaptive management component. The adaptive management component will include triggers and thresholds for groundwater quantity and quality that alert to changing conditions and allow flexibility to address/accommodate new circumstances, adjust monitoring, implement new mitigation measures, and/or modify existing measures, if required. See response to IAAC-73 for further details on the conceptual Groundwater Monitoring Plan; elaborating on the detail provided in the EIS.
Attachment:	Appendix A, Attachment IAAC-62

RESPONSE TO IAAC-63

ID:	**IAAC-63**
Expert Department or Group:	NRCan-08
Guideline Reference	6.1.5 Groundwater and Surface Water
EIS Reference	8.4.2.3 Project Residual Effects Maps 8-22 and 8-23
Information Request:	a. Confirm whether the drawdown contours shown on Maps 8-22 and 8-23 are correct. Provide an updated discussion and/or maps as required.
Response:	a. Maps 8-22 and 8-23 from Chapter 8 (Volume 1) of the Environmental Impact Statement (EIS) have been updated and are provided as an attachment to this response (Map IAAC 63-1 and Map IAAC 63-2, respectively). The maps are consistent with the description provided in Chapter 8 (Volume 1) of the EIS.
Attachment:	Appendix A, Attachment IAAC-63

RESPONSE TO IAAC-64

ID:	**IAAC-64**
Expert Department or Group:	NRCan-09
Guideline Reference	6.1.5 Groundwater and Surface Water
EIS Reference	Volume 4, Appendix H Hydrogeology Baseline Technical Data Report 4.2.1.1 Geology and Hydrostratigraphy 4.2.2.1 Geology and Hydrostratigraphy
Information Request:	a. Provide details of the development of the bedrock topographic surface outside of the areas where drilling information was available. i. Describe any gaps in information and related uncertainty with regards to the assessment of effects to groundwater.
Response:	a. A full description of the hydrostratigraphy, including the overall thickness of the overburden units within the local assessment areas (LAAs) is provided in Volume 1, Chapter 8, Section 8.2.2.1 of the Environmental Impact Statement (EIS). As described in Section 8.2.2.1 (page 8.18), the top of bedrock was interpolated based on available borehole data for the LAA/RAA (regional assessment area). As presented in Map 4A and 4B of the Baseline Hydrogeology Technical Data Report (Volume 4, Appendix H of the EIS) detailed borehole data is available in the Project Development Area (PDA) and the areas where groundwater is predicted to be affected by the Project. Where data was unavailable, the top of bedrock was assumed to be a minimum of 1 m below ground surface, which was generally areas that extended into the LAA and beyond the areas of groundwater that were predicted to be affected by the Project. The locations where data were unavailable fall outside the areas where Project interaction with the groundwater regime were being made. i. Detailed borehole data is available in the PDA and areas extending into the LAA where groundwater may be affected by the Project. The available borehole data used to characterize the existing groundwater conditions for the MacLellan and Gordon sites are sufficient (i.e., no gaps or uncertainty) for assessing the effects of the Project on groundwater. As noted in IAAC-59, the Hydrogeology Baseline Technical Validation Report (Volume 4, Appendix H of EIS) and the MacLellan site Hydrogeology Assessment Technical Modelling Report (Volume 5, Appendix G of EIS) details how the hydraulic conductivity of the predominant overburden units and shallow bedrock is the same order of magnitude and therefore the uncertainty in the top of bedrock is not anticipated to have an effect on the assessment of effects of the Project on groundwater. Follow up monitoring, with a component of adaptive management, is presented in Volume 1, Chapter 8, Section 8.9 of the EIS. The follow up monitoring was designed to confirm the assessment of effects to groundwater; no further modifications to the program are required at this time. There is no uncertainty regarding the assessment of Project effects to groundwater associated with interpolation and the assumptions made with respect to the top of bedrock.
Attachment:	No

RESPONSE TO IAAC-65

ID:	**IAAC-65**
Expert Department or Group:	NRCan-10
Guideline Reference	6.1.5 Groundwater and Surface Water
EIS Reference	Volume 4, Appendix H Hydrogeology Baseline Technical Data Report 4.2.1.4 Estimate of Bedrock Aquifer Parameters Appendix A Map 4A Rock Mass Properties for Surface Mines, in, Slope Stability in Surface Mining, Society for Mining and Metallurgical Exploration; Hoek and Karzulovic (2000).
Information Request:	a. Describe the conceptualization of the fault damage zone. Provide details on the method used to determine the extent of the fault damage zone. b. Discuss the blast damaged zone from the development of the historical pits. Indicate how this zone is limited to within a reasonable distance from the pits.
Response:	a. The East fault and Wendy fault at the Gordon site were delineated on Map 4A of Appendix A of the Hydrogeology Baseline Technical Data Report (Volume 4, Appendix H of the Environmental Impact Statement [EIS]) based on mapping presented in Beaumont-Smith et al. (2000). Beaumont-Smith et al. (2000) studied exploration borehole data as well as the faces of the open pits to understand the structural geology and gold metallogeny of the Farley Lake gold deposit. Beaumont-Smith et al (2000) described the East and Wendy faults as northwest trending and steeply northeast dipping zones of intense fracturing cored by decimetre-scale gouge zones characterized by imbricated clasts, indicating a large component of normal movement. In addition to the East and Wendy faults, Beaumont Smith et al. (2000) describe numerous faults in the area of the open pits, that predate the East and Wendy faults. These faults represent adjustments in response to tight and steeply east plunging folding that occurred. The hydraulic and geophysical testing of bedrock boreholes and/or monitoring wells confirm there is a zone of higher hydraulic conductivity in the area of the open pit. For the purpose of the groundwater flow model, the zone of higher bedrock hydraulic conductivity was delineated based on the geological mapping of the East and Wendy faults, hydraulic conductivity testing, and the calibration and validation of the groundwater flow model. Please refer to response to comment IAAC-69 that includes Figure IAAC-69-4, which presents the extent of the higher hydraulic conductivity zone defined within the groundwater flow model. The following is a list of data that was used in characterizing the location, geometry, and spatial extent of the fault zone as detailed in the EIS and supporting documentation: • Literature review as detailed in Section 2.1 of the Hydrogeology Baseline Technical Data Report (Volume 4, Appendix H of the EIS) that included review of surficial geology and bedrock mapping, topography, and historical geological and hydrogeological investigations. • Geotechnical investigations as summarized in Section 3.3 of the Hydrogeology Baseline Technical Data Report (Volume 4, Appendix H of the EIS).

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- 389 boreholes completed as part of the exploration and condemnation drilling program used to summarize bedrock geology and quality summarized in Volume 1, Chapter 8, Section 8.2.2.1 of the EIS.
- Borehole drilling and single well response testing of 48 boreholes completed as part of environmental baseline studies (refer to Section 8.2.2.1 and 8.2.2.3 of Volume 1, Chapter 8 of the EIS for maps and tables stating the specific borehole locations).
- Packer testing at one geotechnical borehole (GTF-15-05) and geophysical logging of four bedrock boreholes (GPW-01, GPW-02, GPW-03, and GPW-04), as summarized in Section 4.2.1.3 of the Hydrogeology Baseline Technical Data Report (Volume 4, Appendix H of the EIS) and Section 3.2.2.3 of the Hydrogeology Baseline Technical Data Validation Report (Volume 4, Appendix H of the EIS).
- Three pumping tests of boreholes (GPW-01, GPW-02, GPW-04) completed within the fault zone (including analysis of water quality over time) as summarized in Section 4.2.1.4 of the Hydrogeology Baseline Technical Data Report (Volume 4, Appendix H of the EIS).
- Calibration of the groundwater flow model for the Gordon site, which required the higher hydraulic conductivity zone of bedrock, consistent with the field data, to achieve model calibration (Hydrogeology Assessment – MacLellan site, Technical Modelling Report, Volume 5, Appendix G of the EIS).

b. Hoek and Karzulovic (2000) estimate that the blast influenced zone from open pit mining may extend at most 2.5 times the bench height of the development. Langefors and Kihlstrom (1978) note that the fracture zone is approximately proportional to the diameter of the hole (charge) diameter, with typical fracturing around a standard 0.125 m diameter hole not expected to extend greater than 3 m from the blast hole. Therefore, the blast zone is limited to within a reasonably close distance from the historical open pits. GPW-02 and GPW-04 are both at distances greater than the potential blast influenced zone of the historical open pits, therefore it is agreed that the higher hydraulic conductivities of bedrock observed at these locations are likely not attributed to fracturing resulting from historical blasting and likely the result of structural features associated with folding as described in the response to a. above.

References:

Beaumont-Smith, C.J., Lentz, D.R. and Tweed, E.A. 2000: Structural analysis and gold metallogeny of the Farley Lake gold deposit, Lynn Lake greenstone belt (NTS 64C/16); in Report of Activities 2000, Manitoba Industry, Trade and Mines, Manitoba Geological Survey, p. 73-81.

Hoek, E. A. Karzulovic. 2000. Rock Mass Properties for Surface Mines. IN: Slope Stability in Surface Mining, (Edited by W.A. Hustralid, M.K. McCarter, and D.J.A. van Zyl), Littleton, Colorado: Society for Mining, Metallurgical and Exploration (SME), 2000, Pages 59-70.

Langefors, U. and B. Kihlstrom. 1978. The Modern Technique of Rock Blasting. Halsted Press, a division of John Wiley and Sons. New York.

Attachment: No

RESPONSE TO IAAC-66

ID:	**IAAC-66**
Expert Department or Group:	NRCan-11
Guideline Reference	6.1.5 Groundwater and Surface Water
EIS Reference	Volume 4, Appendix H Hydrogeology Baseline Technical Data Report 4.2.1.2 Groundwater Flow 4.2.2.2 Groundwater Flow
Information Request:	a. Describe the wells and screen depths used to compare shallow bedrock to overburden groundwater flow. b. Describe whether groundwater flow patterns or seasonal variability changes with depth, within the bedrock.
Response:	a. An extensive monitoring well network was installed at both the MacLellan and Gordon sites as part of baseline studies to support the EIS (Volume 4, Appendix H of the Environmental Impact Statement [EIS]). At the MacLellan site, there are 89 monitoring wells across a total of 56 locations. Of these, 53 monitoring wells are screened across the bedrock unit at various depths, with the remaining monitoring wells screened in overburden. At the Gordon site, there are 48 monitoring wells across a total of 26 locations. Of these, 27 monitoring wells are screened across the bedrock unit at various depths, with the remaining monitoring wells screened in overburden. Nested monitoring wells consisted of an overburden monitoring well and a bedrock monitoring well. Where possible, the shallow monitoring well was screened at least 2 m below the water table, with the bedrock monitoring well screened up to 5 m below the top of bedrock with the intent to seal the screen below the overburden-bedrock interface. Nested wells with this design allow for the characterization of the overburden and bedrock materials, as well as the determination of vertical hydraulic gradients, connectivity, and groundwater flow patterns between overburden and bedrock. b. As described in the Hydrogeology Baseline Technical Data Report (Volume 4, Appendix H of the EIS), groundwater elevations in shallow bedrock monitoring wells (generally screened less than 10 m below the top of bedrock) were reviewed and resulted in a similar groundwater flow pattern to that observed in overburden. In addition, groundwater level responses to precipitation and seasonal trends were similar in overburden and shallow bedrock monitoring wells. Because of these similarities in groundwater level responses and flow in overburden and shallow bedrock, the overburden and shallow bedrock are interpreted to be hydraulically connected. The similarities in groundwater level responses in overburden and bedrock are consistent with the similar hydraulic conductivity values observed between overburden and bedrock. As presented in Volume 1, Chapter 8, Section 8.2.2.3 of the EIS, the hydraulic conductivity of bedrock decreases by over four orders of magnitude with depth. This decrease in hydraulic conductivity with depth below bedrock limits the

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	propagation of the seasonal effect on groundwater levels with depth below top of bedrock. This conceptual model of groundwater flow patterns and seasonal variability with depth within bedrock is consistent with research of groundwater flow in the Canadian Shield (Sykes et al. 2009). Sykes et al. (2009) supports the characterization that groundwater flow systems in the Canadian Shield are typically short. Groundwater is recharged at higher elevations and discharges at nearby surface water bodies or low lands without developing extensive flow systems in the subsurface. **Reference:** Sykes, J.F., S.D. Normani, M.R. Jensen and E.A. Sudicky. 2009. Regional-scale groundwater flow in a Canadian Shield setting. Canadian Geotechnical Journal. v. 46, pp. 813-827.
Attachment:	No

RESPONSE TO IAAC-67

ID:	**IAAC-67**
Expert Department or Group:	NRCan-12
Guideline Reference	6.1.5 Groundwater and Surface Water
EIS Reference	Volume 4, Appendix H Hydrogeology Baseline Technical Data Report 4.2.2.2 Groundwater Flow
Information Request:	a. Describe the topographic and hydrostratigraphic conditions that result in greater seasonal variability in groundwater elevations. b. Provide an assessment and discussion of the topographic and hydrostratigraphic conditions at GBHM-18, and whether these conditions may occur elsewhere within the MacLellan site LSA.
Response:	a. The context and rationale provided with this information request pertains to the MacLellan site and therefore the response to this information request is focused on the MacLellan site. As described in Section 3.2.2.2 of the Hydrogeology Baseline Technical Data Validation Report (Volume 4, Appendix H of the Environmental Impact Statement [EIS]), the groundwater levels across the MacLellan site generally varied from less than 2 m to up to 4 m. In general, greater seasonal variation was observed at monitoring wells associated with topographic highs or the flanks of topographic highs and lower seasonal variation in areas of topographic lows. These observations are consistent with the conceptual model of groundwater flow and runoff, where steeply inclined topography generally receives less recharge than flat lying areas resulting in less seasonal variation in areas associated with the topographic lows. b. GBHM-18 is a bedrock monitoring well located in the northwestern portion of the MacLellan site Project Development Area (PDA). The depth to the top of bedrock is 15.2 m below ground surface (BGS), and the well is screened from 16.8 m BGS to the base of the borehole at 19.8 m BGS. Overburden at GBHM-18 is characterized by silty sand overlying gravel, interpreted to correspond with the glaciolacustrine nearshore deposit hydrostratigraphic unit. Bedrock is described as a slightly weathered to fresh, massive grey schist with quartz pockets. Based on top of bedrock mapping (Map 8-13 in Chapter 8 [Volume 1] of the EIS), GBHM-18 is interpreted to be located within a local bedrock low. Many other locations where artesian conditions were observed were characterized not only by being on the flank of a topographic high, but also on or near the base of a bedrock slope. Section 4.2.2.2 of the Hydrogeology Baseline Technical Data Report (Volume 4, Appendix H of the EIS) states the locations and description of where artesian conditions were observed, which were at monitoring well locations MWM-01A, MWM-02A, MWM-10A/B, GBHM-07, GBHM-08, GBHM-12, GBHM-13A/B, and GBHM-18 (see Volume 4, Appendix H, Map 4A). These monitoring well locations are associated with the flanks of the topographic highs in the northeastern and northwestern portion of the MacLellan PDA, except for MWM-01A and GBHM-18. MWM-01A was a flowing artesian well encountered when drilling in bedrock and a portion of the lower borehole was sealed to reduce the hydraulic head. MWM-01A

ID:	**IAC-67**
	and GBHM-18 are located in topographic bedrock lows with relatively thicker deposits of overburden.
Attachment:	No

RESPONSE TO IAAC-68

ID:	**IAAC-68**
Expert Department or Group:	NRCan-13 NRCan-14
Guideline Reference	6.1.5 Groundwater and Surface Water
EIS Reference	8.2.2.3 Estimation of Hydraulic Conductivity Volume 4, Appendix H Hydrogeology Baseline Technical Data Report 4.2.2.2 Groundwater Flow 4.2.2.3 Hydraulic Conductivity Volume 5, Appendix G Lynn Lake Gold Project, Hydrogeology Assessment – MacLellan site Technical Modelling Report 3.3.5 Bedrock
Information Request:	a. Provide the bedrock hydraulic testing data in the area of the TMF. b. Provide tables summarizing vertical gradients and hydraulic conductivity testing results for the MacLellan site. c. Describe differences in rock type and RQD in the vicinity of the TMF at the MacLellan site LSA. d. Describe the rationale for a uniform, vertically variable bedrock unit across the LSA in light of the difference noted near the TMF. i. If uncertainty remains, provide a discussion of the gap in information and related uncertainty with regards to the potential effects assessment for groundwater.
Response:	a. A summary of the hydraulic response testing data was provided in Table 2A of Appendix B of the Hydrogeology Baseline Technical Data Validation Report (Volume 4, Appendix H of the Environmental Impact Statement [EIS]). A copy of Table 2A is provided with this response. Monitoring wells BH18-01, BH18-02, BH18-03, BH18-04, BH18-05, BH18-06, BH18-07, GBHM-08, and GBHM-17-04 are located within the footprint of the tailings management facility (TMF) and corresponding hydraulic testing results are presented in Table 2A. b. Tables summarizing vertical hydraulic gradients and hydraulic conductivity testing results for the MacLellan site were presented in Appendix B of the Hydrogeology Baseline Technical Data Validation Report (Volume 4, Appendix H of the EIS). A copy of Table 2A and 3B are provided with this response. c. In the context and rationale associated with this information request, the reviewer states "Section 8.2.2.3 notes that hydraulic conductivity tests in the bedrock below the TMF yielded higher values relative to other areas of the site". This statement is incorrect. Volume 1, Chapter 8, Section 8.2.2.3 of the EIS states that boreholes completed within the footprint of the TMF had lower rock quality designation (RQD) than boreholes completed in other areas of the MacLellan site. Despite the lower RQD, the range of hydraulic conductivity values for boreholes and monitoring wells tested within the footprint of the TMF was consistent with that measured at boreholes and monitoring wells across the remainder of the MacLellan site. Eight boreholes were completed within the footprint of the TMF and have corresponding lithological, RQD, and hydraulic conductivity data. Six of the eight boreholes (BH18-01 to BH18-05 and GBHM-17-04) were completed in amphibole

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	schist with RQD ranging from 10% to 100% and corresponding hydraulic conductivity estimates that range from 7x10^{-7} m/s to 1x10^{-4} m/s with a mean of 2x10^{-5} m/s. Two of the eight boreholes (BH18-06 and BH18-07), located in the northwestern portion of the TMF, were completed in basalt with RQD ranging from 0% to 100% and corresponding hydraulic conductivities of 5x10^{-5} m/s and 2x10^{-7} m/s. A lithological control on hydraulic conductivity is not apparent at the MacLellan site. Despite a generally lower RQD observed within the footprint of the TMF compared to the remainder of the MacLellan site, the estimates of hydraulic conductivity of shallow bedrock within the footprint of the TMF are within the range of hydraulic conductivity that was observed in shallow bedrock across the site which ranged from 2x10^{-4} m/s to 7x10^{-8} m/s with a geometric mean of 1x10^{-5} m/s. d. As noted in the response to c., the hydraulic conductivity within the footprint of the TMF was consistent with the range of values and the mean value for shallow bedrock across the MacLellan site. Therefore, the bedrock in the groundwater flow model was modelled as horizontally uniform and vertically variable with respect to hydraulic conductivity. The existing data are sufficient for assessing the effects of the Project on groundwater, including the quantity of seepage from the TMF. As stated in Volume 1, Chapter 8, Section 8.7 of the EIS, the quantity of seepage from the TMF is conservatively over predicted in two ways. The prediction of recharge rates and seepage from the TMF is based on the final (i.e., maximum) elevation of the TMF dams and TMF reclaim pond at the end of operation. This imposes the highest vertical hydraulic gradient from the TMF reclaim pond at the start of operation and results in a conservative prediciton of seepage rates from the TMF during operation of the Project. In addition, recharge from the TMF is assumed to be carried through to the final receptors. Follow up monitoring will be completed to confirm the assessment of effects of the Project. With respect to groundwater, follow up monitoring will include groundwater quantity (level, pumped volumes) and quality (general chemistry and select dissolved metals) monitoring with an adaptive management component. The adaptive management component will include triggers and thresholds for groundwater quantity and quality that alert to changing conditions and allow flexibility to address/accommodate new circumstances, adjust monitoring, implement new mitigation measures, and/or modify existing measures, if required. See response to IAAC-73 for further details on the conceptual Groundwater Monitoring Plan; elaborating on the detail provided in the EIS.
Attachment:	Appendix A, Attachment IAAC-68

RESPONSE TO IAAC-69

ID:	**IAAC-69**
Expert Department or Group:	NRCan-15
Guideline Reference	6.1.5 Groundwater and Surface Water
EIS Reference	Volume 5, Appendix F Lynn Lake Gold Project, Hydrogeology Assessment – Gordon site Technical Modelling Report Appendix A Maps 5 and 6 Appendix G Lynn Lake Gold Project, Hydrogeology Assessment - MacLellan site Technical Modelling Report Appendix A Maps 5 and 6
Information Request:	a. Provide maps showing the bedrock and surficial geology at the LSA scale for both sites.
Response:	a. Bedrock and surficial geology maps were provided as Maps 4 and 5, respectively, in the Hydrogeology Baseline Technical Data Report Validation Report (Volume 4, Appendix H of the Environmental Impact Statement [EIS]). These maps have been presented on the local assessment area (LAA) scale for the Gordon and MacLellan sites as an attachment to this response (see Maps IAAC-69-1 through IAAC-69-4). Please note, the maps present regional scale geological mapping that may differ from results of the borehole drilling program for the MacLellan and Gordon sites. For example, at the MacLellan site, the regional mapping suggest the tailings management facility (TMF) is predominantly mapped as metavolcanics while the borehole drilling data suggest the majority of the footprint of the TMF consists of amphibole schist. The groundwater flow models were parameterized based on a collection of data, which included regional mapping as well as results of field programs conducted at the local scale.
Attachment:	Appendix A, Attachment IAAC-69

RESPONSE TO IAAC-70

ID:	**IAAC-70**
Expert Department or Group:	NRCan-15
Guideline Reference	6.1.5 Groundwater and Surface Water
EIS Reference	Volume 5, Appendix F Lynn Lake Gold Project, Hydrogeology Assessment – Gordon site Technical Modelling Report 3.3.5.1 Shallow Bedrock Appendix A Map 9
Information Request:	a. Provide details on the location, geometry, and spatial extent of the fault zone (structure, depth, orientation, etc.). Where available, include information from drilling data, surface expression, and the historical pit development. If the vertical and horizontal extents of the fault were investigated through model calibration, include these details. i. If any of the details requested above cannot be provided, describe the gap in information, related uncertainty with regards to potential effects and mitigation, and any additional mitigation measures and/or monitoring and follow-up that would be implemented.
Response:	a. Please see the detailed responses provided for IAAC-60 and IAAC-65, which include all the information requested. i. The characterization of the fault presented in the EIS and in the response to IAAC-60 (a. i and ii) and IAAC-65 (a.) are sufficient to assess the potential effects of the Project on groundwater. The mitigation measures and follow up monitoring presented in Volume 3 of the EIS, in Chapters 20 and 23, respectively, are sufficient to confirm the assessment of effects to groundwater and no additional mitigation measures and/or follow up monitoring are recommended.
Attachment:	No

RESPONSE TO IAAC-71

ID:	**IAAC-71**
Expert Department or Group:	NRCan-16
Guideline Reference	4.3 Study strategy and methodology
EIS Reference	Volume 5, Appendix F Lynn Lake Gold Project, Hydrogeology Assessment – Gordon site Technical Modelling Report 4.1 Model Domain Appendix G Lynn Lake Gold Project, Hydrogeology Assessment - MacLellan site Technical Modelling Report 4.1 Model Domain
Information Request:	a. Describe the development of the numerical mesh for the groundwater models, including information on element edge length, and areas of refinement.
Response:	a. The groundwater model is based on a fully structured triangular mesh (TetGen). The model mesh is simulated to grade from coarser around the limits of the domain, to finer in the vicinity of the surface water features and the area of the proposed infrastructure such as the open pit, mine rock storage area, and tailings management facility. The finer element edge length varies between 10 m to 15 m and the coarser element edge length varies between 120 m to 150 m. Map 10 of the Technical Modelling Reports for Hydrogeology at the Gordon and MacLellan sites (Volume 5, Appendix F and G of the Environmental Impact Statement, respectively) present the model boundaries and the mesh, which highlights the refinement of the model mesh in areas of Project infrastructure and surface water features.
Attachment:	No

RESPONSE TO IAAC-72

ID:	**IAAC-72**
Expert Department or Group:	NRCan-17
Guideline Reference	4.3 Study strategy and methodology
EIS Reference	Volume 5, Appendix F Lynn Lake Gold Project, Hydrogeology Assessment – Gordon site Technical Modelling Report 4.3.3 Lakes and Watercourses Appendix G Lynn Lake Gold Project, Hydrogeology Assessment - MacLellan site Technical Modelling Report 4.3.3 Lakes and Watercourses
Information Request:	a. For both sites, provide a map showing the locations of assigned lake/river boundary conditions, and their assigned head values. b. Where the model domain is terminated at a lakeshore with the lake external to the model (i.e., Simpson and Serge Lakes for Gordon, and Cockeram, Arbour, and Burge Lakes for MacLellan), provide details on the boundary condition applied on the edge of the model domain.
Response:	a. Map 10 of the Hydrogeology Assessment: Gordon site - Technical Modelling Report (Volume 5, Appendix F of the Environmental Impact Statement [EIS]) and Map 10 of the Hydrogeology Assessment: MacLellan site - Technical Modelling Report (Volume 5, Appendix G of the EIS) presents the model domains, including the lake and river boundaries. These maps are attached to this response and have been updated to label each of the lake and river boundaries and a corresponding table has been provided to present the assigned head (see Maps IAAC-72-1 and IAAC-72-2). b. For the MacLellan site, the fluid transfer boundary condition was applied to the edge of the model domain at the lakeshore. The value for the transfer boundary condition was assumed to be 2 m above the lake elevation. For the Gordon site, a constant head boundary condition was applied to the southern boundary of the groundwater flow model to maintain a contact head value throughout the simulation. The values for the boundary conditions are presented in a table attached to this response.
Attachment:	Appendix A, Attachment IAAC-72

RESPONSE TO IAAC-73

ID:	**IAAC-73**
Expert Department or Group:	NRCan-18
Guideline Reference	4.3 Study strategy and methodology
EIS Reference	Volume 5, Appendix F Lynn Lake Gold Project, Hydrogeology Assessment – Gordon site Technical Modelling Report 4.4.2 Calibration to Water Levels, Table 4-2 Appendix G Lynn Lake Gold Project, Hydrogeology Assessment - MacLellan site Technical Modelling Report 4.4.2 Calibration to Water Levels, Table 4-2
Information Request:	a. Update Tables 4-2 to include the screened hydrostratigraphic unit, and highlight the screened units on the calibration plot. b. For the MacLellan site, provide rationale (including the hydrostratigraphy and topographic setting) for the wells with larger differences between simulation and observation. i. Include a discussion of the impact on model results. Describe the associated uncertainty of model results and potential impacts on the assessment of effects to groundwater. Describe any additional mitigation measures and/or monitoring and follow-up that will be implemented.
Response:	a. Table 4-2 from the Gordon and MacLellan Hydrogeology Technical Modelling Reports (Volume 5, Appendix F and G, respectively, of the Environmental Impact Statement [EIS]) have been updated to include screened material and hydrostratigraphic unit and are provided as an attachment to this response (Table IAAC-73-1 and Table IAAC-73-2). b. At the MacLellan site, a larger difference between the simulated and observed water level was observed at monitoring wells MWM-04, MWM-09A/B, and GBHM-06A than at the remaining monitoring wells used in the calibration process. As previously mentioned in response to IAAC-67, the groundwater levels across the MacLellan site generally varied from less than 2 m to up to 4 m. In general, greater seasonal variation was observed at monitoring wells associated with topographic highs or the flanks of topographic highs and lower seasonal variation in areas of topographic lows. These observations are consistent with the conceptual model of groundwater flow and runoff, where steeply inclined topography generally receives less recharge than flat lying areas resulting in less seasonal variation in areas associated with the topographic lows. The four monitoring wells, where greater difference between measured and simulated water levels was observed, are associated with the topographic high and flank of the topographic high north of the open pit where a large range in seasonal water levels were observed. The lower heads simulated at these wells in the vicinity of the open pit and topographic high may result in a localized underprediction of drawdowns at the end of operation and post-closure. However, these effects are not anticipated to change the overall interpretation of effects farther from the open pit where the water level calibration is improved. i. Three of the four monitoring wells where greater difference between measured and simulated water levels was observed are bedrock monitoring wells. As

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mentioned in the response to IAAC-62, a sensitivity analysis was completed to address the potential uncertainty of hydraulic conductivity of the bedrock (see response to IAAC-62). It is noted that the monitoring wells with greater difference between measured and simulated water levels are confined spatially by monitoring well water level calibration targets with a lower difference between measured and simulated water levels.

The characterization of the bedrock and the calibration of the model are sufficient to assess the potential effects of the Project on groundwater. The mitigation measures and follow up monitoring presented in Volume 3 of the EIS, in Chapters 20 and 23, respectivley, are sufficient to confirm the assessment of effects to groundwater. No additional mitigation measures and/or follow up monitoring are recommended, however the following additional details are provided in relation to the Groundwater Management and Monitoring Plan (GMMP) to elaborate on that provided in the EIS.

The objective of the GMMP is to provide a framework for monitoring potential changes in groundwater quantity and quality in relation to the Project. In particular:

- Establish and/or maintain background monitoring locations to differentiate between natural seasonal or climatic variability in groundwater quality and quantity as the Project progresses.
- Monitoring groundwater levels in monitoring wells to document changes in water levels and groundwater flow direction in response to dewatering of the histoircal underground workings, historical open pits, and new open pits, operaton of the interceptor wells at Gordon site, and changes in recharge due to Project components (e.g. mine rock storage areas [MRSAs] and tailings management facility [TMF]).
- Monitoring of groundwater quality to document the effects of changes in groundwater quality asscoiated with the Project components, including the MRSAs and TMF.
- Validate the prediction of environmental effects of the Project on groundwater quality and quantity as presented in the EIS for the Project.
- Validate the initial three dimensional numerical groundwater flow model used in the EIS/EA and update, if required, with new data at routine intervals thorughout operation of the Project.

Follow up monitoring will include groundwater quantity (level, pumped volumes) and quality (general chemistry and select dissolved metals) monitoring with an adaptive management component. The adaptive management component will include triggers and thresholds for groundwater quantity and quality that alert to changing conditions and allow flexibility to address/accommodate new circumstances, adjust monitoring, implement new mitigation measures, and/or modify existing measures, if required. Further details on the adaptive management approach are provided in response to IAAC-108d.ii.

The GMMP will include details on groundwater monitoring locations, how often they will be sampled and what they will be sampled for. The type of monitoring equipment, selection of monitoring stations, frequency of sample collection, and duration of the program will be based on Manitoba Conservation and Climate (MCC) guidelines and liaison with government agencies. However, it is expected

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	that the monitoring program for each site will be comprised of the following key elements: • Water quantity (flow rate and total daily volume) of water pumped from the open pits, historical underground workings, and interceptor wells. • Groundwater levels in monitoring wells within overburden and bedrock to monitor the effects of open pit dewatering. • Groundwater levels in monitoring wells located upgradient, cross gradient, and downgradient of the TMF and MRSAs to monitor for changes in groundwater flow regime due to Project development. • Groundwater levels in background monitoring wells to continue to track seasonal variations. • Select monitoring wells will be instrumented with data loggers to allow automatic recording of groundwater levels at a pre-defined interval (minimum of 1 hour to maximum of once a day). • Water quality sampling of water pumped from the open pits, interceptor wells, historical underground workings, and historical open pits. • Groundwater quality sampling of monitoring wells installed upgradient, cross gradient, and downgradient of the TMF and MRSAs to monitor for changes in groundwater quality due to Project development. • Groundwater quality samples from select monitoring wells will be monitored in spring, summer, and fall during construction, operation, and decommissioning/ closure with the frequency progressively reduced based on monitoring results and Project phase. Winter groundwater sampling is not feasible as, based on the baseline data, the monitoring wells are generally frozen. Groundwater quality samples will be analyzed for general chemistry and select dissolved metals. Groundwater monitoring results will be summarized in annual reports that will be provided, by the end of each calendar year, to the Impact Assessment Act Agency of Canada (IAAC), Environment and Climate Change Canada (ECCC), Fisheries and Oceans Canada (DFO), local Indigenous Nations, and/or the environmental committee established for the Project. Finalization of the GMMP will occur during the permitting stage of Project planning (i.e., following receipt of a federal Decision Statement for the Project under CEAA 2012 and provincial licences for the Project under *The Environment Act* of Manitoba) and will be completed prior to the start of Project construction.
Attachment:	Appendix A, Attachment IAAC-73

RESPONSE TO IAAC-74

ID:	**IAAC-74**
Expert Department or Group:	NRCan-19
Guideline Reference	6.1.5 Groundwater and Surface Water
EIS Reference	Volume 5, Appendix F Lynn Lake Gold Project, Hydrogeology Assessment – Gordon site Technical Modelling Report 4.4.2 Calibration to Water Levels Appendix G Lynn Lake Gold Project, Hydrogeology Assessment - MacLellan site Technical Modelling Report 4.4.2 Calibration to Water Levels
Information Request:	a. Describe the hydrostratigraphy, topography, groundwater flow regimes, and groundwater-surface water interactions for wells that display seasonal variability in groundwater elevations. b. Where the groundwater models are unable to simulate the seasonal variability, provide a rationale, describe related uncertainty and how differences may affect assessment results. Describe any additional mitigation measures and/or monitoring and follow-up that will be implemented.
Response:	a. Please refer to response to comment IAAC-67a. As noted in IAAC-67a, greater seasonal variation is observed in topographic highs and less in topographic lows. The areas of topographic highs receive less recharge and are less likely to have groundwater-surface interactions because surface water features are associated with the topographic lows. In areas of topograhic lows, there is generally +/- 1m seasonal variation in groundwater levels. The groundwater levels in topographic lows may vary with surface water stage, however the groundwater level would mimic the variation in stage and therefore the groundwater flow direction would remain towards the surface water feature. b. The MacLellan site groundwater flow model was unable to reproduce the seasonal recharge responses at select monitoring wells in spite of efforts to vary the recharge on a monthly basis and adjusting the storage parameters over the expected ranges during calibration. It is anticipated that the lack of these responses is due to the boundary conditions at the lakes and streams which were maintained at a constant stage throughout the year. The Gordon site groundwater flow model was able to produce reasonable matches to the shape of the observed water level trends by varying the recharge on a monthly basis and adjusting the storage parameters over the expected ranges during calibration. However, the Gordon site groundwater flow model was relatively insensitive to the calibration parameters adjusted at monitoring wells with more than 1 m of variability in the transient water level hydrograph. The ability of the groundwater flow models to fit the transient water level responses does not affect the ultimate prediction of effects of the Project on groundwater. The groundwater model was used in steady state to understand the ultimate effect of the Project at the end of construction, operation, and closure on groundwater levels, flow, and discharge to surface water features. While there may be some seasonal effect on the ultimate drawdown predictions as a result of the Project, the overall seasonal variation (less than 2 m to about 4 m in baseline field data) is a

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	fraction of the change in groundwater level as a result of the Project (e.g., open pit dewatering). Therefore, the seasonal variation in groundwater levels will not alter the conclusions of the assessment of effects of the Project on groundwater. Follow up monitoring will be completed to confirm the assessment of effects of the Project. The follow up monitoring and mitigation measures presented in Volume 1, Chapter 8, Section 8.8 of the EIS account for the uncertainty identified in response to this IR in the assessment of effects to groundwater and no further modifications to the program are required at this time. With respect to groundwater, follow up monitoring will include groundwater quantity (level, pumped volumes) and quality (general chemistry and select dissolved metals) monitoring with an adaptive management component. The adaptive management component will include triggers and thresholds for groundwater quantity and quality that alert to changing conditions and allow flexibility to address/accommodate new circumstances, adjust monitoring, implement new mitigation measures, and/or modify existing measures, if required. See response to IAAC-73 for further details on the conceptual Groundwater Monitoring Plan; elaborating on the detail provided in the EIS.
Attachment:	No

RESPONSE TO IAAC-75

ID:	**IAAC-75**
Expert Department or Group:	NRCan-20
Guideline Reference	6.1.5 Groundwater and Surface Water
EIS Reference	Volume 5, Appendix F Lynn Lake Gold Project, Hydrogeology Assessment – Gordon site Technical Modelling Report 4.4.3 Calibration to Baseflow Appendix G Lynn Lake Gold Project, Hydrogeology Assessment – MacLellan site Technical Modelling Report 4.4.3 Calibration to Baseflow
Information Request:	a. Describe the availability of data within the region for determination of low flow statistics and the degree to which groundwater may contribute to annual surface water flow quantities. Where reasonable analogs are available, provide a comparison of those to the groundwater model results. i. If the details requested above cannot be provided, describe the related uncertainty with regards to potential effects assessment results and mitigation, and any additional mitigation measures and/or monitoring and follow-up that will be implemented.
Response:	a. The regional hydrological stations operated by Water Survey of Canada (WSC) monitor watersheds are substantially larger than the majority of the watersheds that interact with the Lynn Lake Gold Project. Thus, the data that could potentially be derived from these WSC stations would not be analogous to the Project site streams. Most of the smaller streams in the Project area freeze to the bed during the winter and baseflow (i.e., groundwater) contribution is likely negligible. The lower flow periods in the winter, typically March and April, likely represent baseflow in these systems. The estimated flows produced by the groundwater models for the three climate scenarios modelled represent a sufficient characterization of low flows for environmental assessment purposes. i. Management and monitoring plans will describe (as applicable) the location of interventions, planned protocols, lists of measured parameters, analytical methods employed, schedule, resources required as well as parameters to be monitored, methodology and equipment to be used, frequency, duration of monitoring, adaptive management triggers/thresholds, and reporting requirements. Finalization of management and monitoring plans will occur during the permitting stage of Project planning (i.e., following receipt of a federal Decision Statement for the Project under CEAA 2012 and provincial licences for the Project under *The Environment Act* of Manitoba) and will be completed prior to the start of Project construction. Refer to the response to IAAC-73 above for details of the conceptual Groundwater Monitoring Plan. Details of the conceptual Surface Water Monitoring and Management Plan (SWMMP) are provided in the response to IAAC-108 below. The SWMMP will include confirmation of baseflow assumptions for relevant surface water features. The follow up monitoring and mitigation measures presented in Volume 1, Chapters 8 and 9 of the EIS and in Volume 3, Chapters 20 and 23 of the EIS,

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	as well as in the responses to IAAC-73 above and IAAC-108 below, are sufficient to confirm the assessment of effects to groundwater and surface water, respectively. No additional mitigation measures or further modifications to the proposed monitoring are required at this time.
Attachment:	No

RESPONSE TO IAAC-76

ID:	**IAAC-76**
Expert Department or Group:	NRCan-21
Guideline Reference	6.1.5 Groundwater and Surface Water
EIS Reference	Volume 5, Appendix F Lynn Lake Gold Project, Hydrogeology Assessment – Gordon site Technical Modelling Report 4.4.4 Calibrated Model Parameters Table 4-3 Appendix G Lynn Lake Gold Project, Hydrogeology Assessment - MacLellan site Technical Modelling Report 4.4.4 Calibrated Model Parameters Table 4-3
Information Request:	a. Provide an assessment of fracture orientation for the fault zone at the Gordon site. Describe the effect of fracture orientation on groundwater flow. b. Describe the anisotropy that may result from the interbedding of nearshore and offshore glaciolacustrine deposits at the MacLellan site. c. Describe the effect of the inclusion of anisotropy on model calibration, and where necessary, model results. Update the assessment if required following this analysis.
Response:	a. Beaumont and Lentz (2000) and Beaumont et al. (2000) describe the structural geology of the MacLellan and Gordon sites in detail. Fracture orientation logging was completed on boreholes drilled in the vicinity of the open pits. Borehole logs, including logs with fracture orientation, are provided as an appendix to the Hydrogeology Baseline Technical Data Validation Report (Volume 4, Appendix H of the EIS). There was no preferential orientation of the fractures within the logged boreholes, which means an equivalent porous medium (EPM) approach is sufficient to characterize groundwater flow. An EPM approach was selected to simulate the flow within the overburden and underlying bedrock for the purposes of the assessment of effects of the Project on groundwater. Section 4 of the Hydrogeology Assessment Technical Modelling Reports for the MacLellan and Gordon sites (Volume 5, Appendices F and G of the Environmental Impact Statement [EIS], respectively) presents the EPM approach including implications and assumptions of the approach to the modelling results. For the Gordon site, pumping tests completed in bedrock boreholes were completed and included an assessment of the extent and orientation of groundwater level drawdown with pumping in addition to water quality sampling (including isotope analysis). The results of the pumping tests indicated there is hydraulic connection of the fractured shallow bedrock zone in the vicinity of the open pits and that flow is preferential from the lakes to the open pits. These results are consistent with the groundwater flow model predictions. The results of the pumping test analysis are summarized in the Hydrogeology Baseline Technical Data Report (Volume 4, Appendix H of the EIS). b. The interbedding of nearshore and offshore glaciolcustrine deposits across the MacLellan site is discontinuous, limiting the potential for significant vertical anisotropy.

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	c. A vertical anisotropy ratio of 1:1 was applied to the overburden materials at the MacLellan site, as the layered nature of the overburden, including layers with higher and lower hydraulic conductivity, were assumed to be sufficient to capture the effective vertical anisotropy at the site. Layers of higher and lower hydraulic conductivity were observed at the site, and it was expected that this layering would have the same effect on vertical anisotropy between model layers of different properties as explicitly assigning a vertical anisotropy ratio. It is noted that the ability to calibrate the model to the site observations suggests that this assumption is reasonable at this site. **References:** Beaumont-Smith, C.J. and D.R. Lentz. 2000. Preliminary structural analysis of the Agassiz Metallotect near the MacLellan and Dot Lake gold deposits, Lynn Lake greenstone belt (parts of NTS 64C/14,/15); in Report of Activities 2000, Manitoba Industry, Trade and Mines, Manitoba Geological Survey, p. 51-56. Beaumont-Smith, C.J., D.R. Lentz, E.A. Tweed. 2000. Structural analysis and gold metallogeny of the Farley Lake gold deposit, Lynn Lake greenstone belt (NTS 64C/16); in Report of Activities 2000, Manitoba Industry, Trade and Mines, Manitoba Geological Survey.
Attachment:	No

RESPONSE TO IAAC-77

ID:	**IAAC-77**
Expert Department or Group:	NRCan-22
Guideline Reference	6.1.5 Groundwater and Surface Water
EIS Reference	Volume 4, Appendix H Hydrogeology Baseline Technical Data Report Appendix A Map 13 Volume 5, Appendix F Lynn Lake Gold Project, Hydrogeology Assessment – Gordon site Technical Modelling Report 5.1 Baseline Conditions Appendix A Map 12
Information Request:	a. Provide a comparison between simulated and observed horizontal gradients in the vicinity of the groundwater divide to the south of the open pits at the Gordon site for baseline conditions. Describe the differences where apparent. b. Describe the uncertainty related to the simulated groundwater flow with regards to the assessment of effects to groundwater. Describe any additional mitigation measures and/or monitoring and follow-up that will be implemented.
Response:	a. Map 8-15 in Chapter 8 (Volume 1) of the Environmental Impact Statement (EIS) provides both the observed and simulated groundwater elevations in overburden for the Gordon site for direct comparison. The horizontal hydraulic gradient (based on observed groundwater levels) ranges from 0.016 m/m to 0.030 m/m in the area south of the proposed open pit. The simulated horizontal hydraulic gradient in the area south of the proposed open pit ranges from 0.006 m/m to 0.025 m/m. Therefore a reasonable match between the magnitude of observed and simulated horizontal hydraulic gradients in the area south of the open pit was obtained. The groundwater flow direction and magnitude of the horizontal hydraulic gradient does vary slightly in direction when comparing observed and simulated gradients. However, the ultimate receiver at the end of the groundwater flow paths remain unchanged. b. The assessment of effects of the Project on groundwater quality were conservative in that there was no attenuation or chemical reactions of parameters along the groundwater flow paths as a result the quantification of mass loading of parameters to the receiver. Therefore, slight variations in flow paths from the area of the proposed mine rock storage area to the ultimate receivers will not ultimately change the conclusion of the effects of the Project on groundwater. The uncertainty associated with the groundwater flow in the effects assessment was characterized in the Hydrogeology Assessment: Gordon site Technical Modelling Report (Volume 5, Appendix F of the EIS). Section 5.3.2.2 of this Technical Modelling Report characterized the effects of varying the hydraulic conductivity of the bedrock on the predicted dewatering rates in the open pit. The total inflow to the open pit was sensitive to the value of hydraulic conductivity assigned to the faulted shallow bedrock, particularly as the hydraulic conductivity increases. Varying the hydraulic conductivity of the shallow bedrock by two orders of magnitude resulted in less than a 30% change in the total estimated dewatering required for the open pit and interceptor wells. However, varying the faulted bedrock hydraulic conductivity by the same range resulted in much larger changes to the total dewatering rate, from 47 to 114%.

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	Section 5.4.2.3 of the Technical Modelling Report characterized the effects of variable recharge rates on groundwater discharge rates, and indicated that groundwater discharge to watercourses and lakes is relatively insensitive to variations in recharge. The baseline monitoring well network, characterization of the bedrock, and the calibration of the groundwater flow model are sufficient to assess the potential effects of the Project on groundwater, particularly with respect to groundwater flow. A summary of mitigation measures and follow up monitoring are presented in Volume 3 of the EIS, in Chapters 20 and 23, respectively. Management and monitoring plans will describe (as applicable) the location of interventions, planned protocols, lists of measured parameters, analytical methods employed, schedule, resources required as well as parameters to be monitored, methodology and equipment to be used, frequency, duration of monitoring, adaptive management triggers/thresholds, and reporting requirements. Finalization of management and monitoring plans will occur during the permitting stage of Project planning (i.e., following receipt of a federal Decision Statement for the Project under CEAA 2012 and provincial licences for the Project under *The Environment Act* of Manitoba) and will be completed prior to the start of Project construction. Follow up monitoring will be completed to confirm the groundwater assessment of effects of the Project, which will include the placement of monitoring wells upgradient, downgradient, and cross-gradient to mine features to reaffirm groundwater flow direction. Based on the assessment of effects of the Project on groundwater and uncertainty analyses, including groundwater flow direction, no additional mitigation measures and/or follow up monitoring are recommended beyond that presented in the EIS. With respect to groundwater, follow up monitoring will include groundwater quantity (level, pumped volumes) and quality (general chemistry and select dissolved metals) monitoring with an adaptive management component. The adaptive management component will include triggers and thresholds for groundwater quantity and quality that alert to changing conditions and allow flexibility to address/accommodate new circumstances, adjust monitoring, implement new mitigation measures, and/or modify existing measures. See response to IAAC-73 for further details on the conceptual Groundwater Monitoring Plan; elaborating on the detail provided in the EIS.
Attachment:	No

RESPONSE TO IAAC-78

ID:	**IAAC-78**
Expert Department or Group:	NRCan-23
Guideline Reference	4.3 Study strategy and methodology
EIS Reference	Volume 5, Appendix F Lynn Lake Gold Project, Hydrogeology Assessment – Gordon site Technical Modelling Report 5.2.1.1 Dewatering East and Wendy Pits Appendix G Lynn Lake Gold Project, Hydrogeology Assessment – MacLellan site Technical Modelling Report
Information Request:	a. Provide the details of the parameterization of the FTM plugin for both sites.
Response:	a. Please see attached memorandum for response to IAAC-78 documenting the parameterization of the Freeze Thaw Module (FTM) plug in for the groundwater flow models.
Attachment:	Appendix A, Attachment IAAC-78

RESPONSE TO IAAC-79

ID:	**IAAC-79**
Expert Department or Group:	NRCan-24
Guideline Reference	6.2.2 Changes to groundwater and surface water
EIS Reference	Volume 5, Appendix F Lynn Lake Gold Project, Hydrogeology Assessment – Gordon site Technical Modelling Report 5.2.1.1 Dewatering East and Wendy Pits 5.3.2.1 Open Pit Dewatering Tables 5-1 to 5-3 Appendix A Maps 15 and 18
Information Request:	a. For the small unnamed lake to the north of the open pits, provide changes in the groundwater flux to/from the lake for all simulated phases of the Project (construction, operation, and closure). i. Describe whether the catchment area for this lake would be sufficient to sustain the quantity of water lost to the groundwater flow system under pit dewatering conditions. In doing so, ensure that fluxes used to describe groundwater-surface water interactions are in consistent units (i.e., m^3/day). b. Provide a rationale for the decrease in flux from lakes to the groundwater flow system, for the lakes to the south of the open pit during operations and construction phases. i. Describe remaining uncertainties in the groundwater flow model with regards to the groundwater effects assessment and mitigation, and any monitoring and follow-up that will be implemented to verify the assessment predictions.
Response:	a. The groundwater discharge to the surface water features in the watershed associated with the unnamed lake located north of the East Pit at the Gordon site is presented as follows for each phase of mine life: • Baseline: -3.5 m^3/day • Construction: -18 m^3/day • Operation: -97 m^3/day • Closure: -3.5 m^3/day (Positive value represents flow from groundwater to surface water, negative value represents flow from surface water to groundwater) i. The mean annual flow in the unnamed lake watershed is about 1,336 m^3/day. The change in recharge of surface water to groundwater from the unnamed lake watershed at the end of operation represents 7% of the mean annual flow. Therefore, the dewatering of the open pit at the Gordon site is not predicted to have a significant effect on the mean annual flow of the unnamed lake watershed during operation. In closure, as dewatering ceases and the pit lake is formed, the rate of recharge of surface water to groundwater from the unnamed lake watershed returns to baseline conditions. This interpretation is consistent with historical landsat imagery, which shows no notable changes in the shoreline of the unnamed lake when the East and Wendy pits were dewatered historically. b. Open pit dewatering is not predicted to notably affect groundwater discharge to Susan and Marnie lakes. The predominant pathway of groundwater into the open

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	pit is through the shallow flow system (i.e., overburden and weathered bedrock). The elevation of the water levels in Susan and Marnie lakes are 10 to 20 m lower than the top of the open pit compared to the north of the open pit which is topographically higher than the open pit. In addition, Susan and Marnie lakes are located on the opposite side of a groundwater flow divide compared to the open pit. Therefore, the effect of open pit dewatering isn't observed on lakes to the south of the open pit to the same degree as surface water features located near or north of the open pit. i. A variety of sensitivity scenarios were completed throughout the Environmental Impact Statement (EIS) to quantify the uncertainty with model predictions (refer to the Gordon site Hydrogeology Assessment Technical Modelling Report [Volume 5, Appendix F of the EIS] for sensitivity scenarios related to groundwater predictions). In particular, the uncertainty for groundwater fluxes to lakes to recharge is characterized in Section 5.4.2.3 of the Technical Modelling Report, and was found to be relatively insensitive to a 25% increase or decrease in recharge rates. The characterization of bedrock from field data, calibration of the groundwater flow model, and the related sensitivity analysis with respect to groundwater discharge are sufficient to assess the potential effects of the Project on groundwater, particularly with respect to groundwater dischage. A summary of mitigation measures and follow up monitoring are presented in Volume 3 of the EIS, in Chapters 20 and 23, respectively. Follow up monitoring will be completed over the life of the Project to confirm the assessment of effects of the Project, which includes confirmation of stream flow (baseflow) in nearby creeks. Based on the assessment of effects of the Project on groundwater and uncertainty analyses, including sensitivity of prediction of effects on groundwater discharge, no additional mitigation measures and/or follow up monitoirng are recommended beyond that presented in the EIS. With respect to groundwater and surface water, follow up monitoring will include quantity (level, pumped volumes, discharge rates) and quality (general chemistry and select dissolved metals) monitoring with an adaptive management component. The adaptive management component will include triggers and thresholds for water quantity and quality that alert to changing conditions and allow flexibility to address/ accommodate new circumstances, adjust monitoring, implement new mitigation measures, and/or modify existing measures, if required. Additional information on groundwater and surface water monitoring is provided as well in IAAC-73 and IAAC-108, respectively.
Attachment:	No

RESPONSE TO IAAC-80

ID:	**IAAC-80**
Expert Department or Group:	NRCan-25
Guideline Reference	4.3 Study strategy and methodology
EIS Reference	Volume 5, Appendix F Lynn Lake Gold Project, Hydrogeology Assessment – Gordon site Technical Modelling Report 5.3.1.1 Open Pit Dewatering Appendix G Lynn Lake Gold Project, Hydrogeology Assessment - MacLellan site Technical Modelling Report 5.3.1.1 Open Pit Dewatering
Information Request:	a. Provide the details of the simulated pit depth for each of the modelled phases of the Project.
Response:	a. For the Gordon site, the open pit depths were simulated in the groundwater flow model as follows: • Construction – the existing East and Wendy pits, which extend to 83 m and 60 m, respectively. • Operation – an intermediate open pit depth of 91 m and an ultimate open pit depth of 197 m. • Closure – pit depth of 197 m with a pit lake elevation of 315 m amsl. For the MacLellan site, the open pit depths were simulated in the groundwater flow model as follows: • Construction – a starter pit depth of 27 m. • Operation – an intermediate open pit depth of 155 m and an ultimate open pit depth of 396 m. • Closure – pit depth of 396 m with a pit lake elevation of 330 m amsl.
Attachment:	No

RESPONSE TO IAAC-81

ID:	**IAAC-81**
Expert Department or Group:	MMF-06 NRCan-26
Guideline Reference	6.2.2 Changes to groundwater and surface water
EIS Reference	Volume 4, Appendix H Hydrogeology Baseline Technical Data Report 4.2.1.4 Estimate of Bedrock Aquifer Parameters Volume 5, Appendix F Lynn Lake Gold Project, Hydrogeology Assessment – Gordon site Technical Modelling Report 5.3.1.2 Groundwater Interceptor Wells Appendix A Map 18
Information Request:	a. Describe whether all of the simulated interceptor wells remained operable during operations simulations. b. Describe the remaining depth of water above the simulated screen base of the interceptor wells. c. Given that the pumping ability has been shown to be a strong function of well location (within or outside of the fractured zone), provide any preliminary details for the design plan for well placement to ensure the simulated pumping rate is achieved. i. If this information is not available, provide the criteria that the plan design will be based on. d. Describe the effectiveness of the well capture system. i. Provide an alternative analysis that demonstrates the reasoning behind why the well capture system is the preferred option relative to other alternatives, such as a grout curtain or cut off trench. ii. Describe whether the well capture system provides benefits for the lake and the water management requirements of the mine relative to potential alternatives.
Response:	a. As indicated in Section 5.3.1.2 of the MacLellan Hydrogeology Assessment Technical Modelling Report (Volume 5, Appendix F of the Environmental Impact Statement [EIS]), all of the groundwater interceptor wells remained operational through the operation phase of mine life to control inflows to the open pit. Please see response to comment b. for additional details. b. The simulation of the interceptor wells allowed the full depth of the well to be dewatered. As such, there was no remaining depth of water above the simulated screen base of the interceptor wells, although the dewatering rates continued at the rates presented in the EIS. The interceptor well arrangment presented in the EIS is conceptual in nature, and additional testing will be completed to confirm the final depth and diameter of the interceptor wells as part of the detailed design of the water management system at the Gordon site. In addition, follow up monitoring will be completed to confirm the assessment of effects of the Project. With respect to groundwater, follow up monitoring will include groundwater quantity (level, pumped volumes) and quality (general chemistry and select dissolved metals) monitoring with an adaptive management component. The adaptive management component will include triggers and thresholds for groundwater quantity and quality

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that alert to changing conditions and allow flexibility to address/accommodate new circumstances, adjust monitoring, implement new mitigation measures, and/or modify existing measures, if required. Additional information on the Groundwater Management and Monitoring Plan components is provided in IAAC-73.

c. The detailed design of the interceptor wells will be completed as the Project moves into the detailed design phase. Additional field testing (e.g., pumping tests) will be completed to confirm potential pumping rates and interactions. These data will be used to complete detailed design of the interceptor wells including pumping rate and zone of influence. That information will be used to determine the number of wells required and their placement.

   As outlined in IAAC-73, the conceptual Groundwater Management and Monitoring Plan will describe the location of interventions, planned protocols, lists of measured parameters, analytical methods employed, schedule, resources required as well as parameters to be monitored, methodology and equipment to be used, frequency, duration of monitoring, adaptive management triggers/thresholds, and reporting requirements.

   i. The objective of the interceptor wells is to intercept groundwater flowing from Gordon Lake and/or Farley Lake to the open pit prior to entering the open pit and pumping the water back to the lakes to maintain the lake levels sufficient that there is no adverse effect of dewatering on Gordon and Farley lakes. Therefore, the interceptor wells will be designed based on the following criteria: spatial extent of the fracture zone (based on detailed borehole drilling completed through exploration, geotechnical, and environmental drilling), radius of influence of pumping for each interceptor well (extent of the drawdown cone), and the ability to maintain the water levels within Gordon and Farley lakes. The pumping rate may vary from the simulated pumping rate if an inward gradient toward the interceptor wells is maintained and the water pumped back to the lakes is sufficent to maintain the lake levels at a level where no adverse effect of the Project is measured.

d. The “well-capture system” or interceptor wells are described in Volume 1, Chapter 2, Section 2.3.1.4 of the EIS. As noted therein, a series of groundwater interceptor wells located between the ultimate footprint of the open pit and Gordon and Farley lakes will be used to mitigate a reduction in groundwater discharge to Gordon and Farley lakes as a result of open pit dewatering during mine operations and pit filling during mine closure. At this time, the interceptor wells are anticipated to be sited between the pit and the nearby lakes approximately 40 m from the boundary of the ultimate open pit limit. Groundwater extracted from the interceptor wells (originating from the adjacent lakes) will be pumped to a water management pond prior to being recirculated to the lakes. If required, the water will be treated to meet applicable federal and provincial regulatory requirements prior to discharge to the environment. The engineering design for these wells will be finalized during the detailed design phase for the Project.

   i. Alternative analysis for mitigating inflow to the open pit was completed at the start of the Project. The alternative analysis included the evaluation of a seepage cut off wall and grout curtain. The results of the analysis indicated that the flow would bypass the seepage cut-off wall and grout curtain and enter the open pit regardless. The modelled interceptor wells were predicted to mitigate inflows to the open pit and allow flexibility in placement. The

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	interceptor wells are also a temporary feature for the life of the Project as opposed to permanent placement of a seepage cut off wall. ii. Through groundwater flow modelling alternative analysis, it was not possible to stabilize Gordon and Farley lakes with the seepage cut-off wall or grout curtain. The interceptor wells were carried through the assessment of effects in groundwater and to surface water. The results of the groundwater flow modelling of the interceptor wells (number of interceptor wells and associated discharge rate) were carried forward into the water balance model, which resulted in the assessment of effects on surface water. Through the integrated groundwater and surface water prediction of effects of the Project, the interceptor wells have been shown to limit the potential dewatering of Gordon and Farley lakes. The results of the groundwater flow modelling with respect to the interceptor wells are presented in Volume 5, Appendix F, Section 5.0 of the EIS. These results were carried forward into modelling the effect of the interceptor wells on surface water as part of the water balance model, which is presented in Volume 5, Appendix D, Section 4.0 of the EIS and also discussed in the May 2021 supplemental filing regarding the adjustment to the mine rock storage area at the Gordon site. Please refer to these technical modelling reports, which detail how the interceptor wells sufficiently limit the potential dewatering of Gordon and Farley lakes.
Attachment:	No

RESPONSE TO IAAC-82

ID:	**IAAC-82**
Expert Department or Group:	MCCN-36
Guideline Reference	4.3 Study strategy and methodology
EIS Reference	9.4.1.1 Analytical Assessment Methods for Surface Water Quantity
Information Request:	a. Provide detailed rationale for the use of the referenced climate scenarios for the water balance estimation and include an explanation for how climate change (i.e., a shifting climate regime over the Project lifespan and following decommissioning/ closure) was considered in selecting these parameters. i. If climate change was not considered, provide a revised analysis to incorporate a climate parameter that accounts for the effects of current and projected climate change.
Response:	a. The climate normals for the period 1981-2010 from the Environment Canada and Climate Change station Lynn Lake A were selected to represent long-term average precipitation conditions for the Project (478 mm/yr). In addition to the long-term average data set, the 1:25 year wet (655 mm/yr) and dry (344 mm/yr) annual precipitation scenarios were generated using the annual precipitation time series from the Lynn Lake A station. Model runs for the duration of the Project (i.e., from construction to post-closure) were completed for each of the scenarios (average, wet, and dry), assuming static climate conditions. Information from the Climate Atlas shows average climate predictions for the Municipality of Lynn Lake annual precipitation under the RCP 8.5 scenario (high carbon climate future) to be 523 mm/yr for the period of 2021-2050 and 545 mm/yr for the period of 2051-2080. While climate change was not addressed specifically by the modelling scenarios, the predicted climate change average annual precipitation values (523 mm and 545 mm) are within the range of the average, dry, and wet scenarios (344 mm to 655 mm) that were used for water balance modelling. i. Information is provided under a. above. **Reference:** Climate Atlas of Canada. Municipality of Lynn Lake. Available at: https://climateatlas.ca/data/city/38/plus30_2030_85/line
Attachment:	No

RESPONSE TO IAAC-83

ID:	**IAAC-83**
Expert Department or Group:	MCCN-26 MCCN-27 MCCN-28, NRCan-27
Guideline Reference	6.2.2 Changes to groundwater and surface water 6.6.2 Effects of the environment on project
EIS Reference	8.4.3.3 Project Residual Effects Volume 5, Appendix F Lynn Lake Gold Project, Hydrogeology Assessment – Gordon site Technical Modelling Report 5.3.1.3 Seepage Collection System Appendix G Lynn Lake Gold Project, Hydrogeology Assessment - MacLellan site Technical Modelling Report 5.3.1.3 Seepage Collection System
Information Request:	a. Provide the rate of infiltration calculated for the MRSAs from the water balance models. Provide the distribution of this water between the seepage collection system and groundwater recharge as calculated using the SEEP/W model. b. Provide details of the integration of the SEEP/W model results into the groundwater flow model including the applied recharge. i. Include the simulated flux of water that enters the model from the MRSA recharge boundary (i.e., comment on whether all of the applied recharge enters the groundwater model, and whether groundwater mounding occurs). c. Provide the effective porosities used in the calculation of travels times from the various mine facilities to their down gradient receptors. d. Describe the potential (if any) for seepage under transient conditions (i.e., before reaching a steady-state saturation condition) for MRSAs for all Project sites. Update the effects assessment with this information, or provide a rationale for why this potential (if identified) was not considered in assessing Project effects to groundwater quality. e. Provide rationale for the chosen recharge rate from the new MRSA of 50% of the infiltration rate during operation. Include the basis for using a constant value across the 17 to 28-year wetting period. f. Provide a supplementary analysis for worst-case for seepage quality and groundwater recharge quality based on a sensitivity scenario that uses a 100- year dry climate year to determine the pore water volumes. g. Provide supporting rationale, for the selection of an appropriate sensitivity scenario, taking into consideration the full range of variability for the existing hydrologic dataset and the predicted effects of climate change (i.e., a shifting climate regime over the Project lifespan and following decommissioning/closure).
Response:	a. For reference, Appendix K of the Hydrology Water Balance and Water Quality Impact Assessment: Gordon site - Technical Modelling Report (Volume 5, Appendix D of the Environmental Impact Statement [EIS]) details the Seep/W modelling of the mine rock storage area (MRSA). The average annual precipitation rate for the MacLellan and Gordon sites is 244 mm/year. The infiltration rate into the MRSA was assumed to be 50% of the annual

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average precipitation. The inflow rate was distributed to macropore and micropore flow to quantify total flow through the MRSA.

We have assumed that 60% of the flow at the MRSA/subsurface boundary seeps into the collection system at the toe of the MRSA and 40% recharges groundwater through the base of the MRSA. The distribution of toe and base seepage of the MRSA is based on an applied infiltration factor discussed in Appendix K of the Hydrology Water Balance and Water Quality Impact Assessment: Gordon site - Technical Modelling Report (Volume 5, Appendix D of the EIS).

b. The base seepage from the MRSA is applied to the groundwater flow model. For operation, the recharge rate from the MRSA is 50% of the base seepage from the MRSA to account for "wetting up" of the MRSA. In closure, the recharge rate from the MRSA is 100% of the base seepage from the MRSA to account for steady state saturation of the MRSA. Please refer to response to comment e. for further details. Mounding was not predicted beneath the MRSA at the Gordon site. Mounding was predicted at the MacLellan site as a result of the tailings management facility (TMF) (Volume 5, Appendices F and G of the EIS).

c. For the Gordon site groundwater flow model (Volume 5, Appendix F of the EIS), uniform porosity was applied to each hydrostratigraphic unit as follows:

- Historical MRSA: 0.44
- Organics: 0.19
- Glaciolacustrine Offshore: 0.16
- Glaciolacustrine Nearshore: 0.16
- Sand Diamicton: 0.2
- Shallow Bedrock: 0.0001
- Faulted Zone: 0.01
- Upper Bedrock: 0.2
- Intermediate Bedrock: 0.2
- Deep Bedrock: 0.2

For the MacLellan site groundwater flow model (Volume 5, Appendix G of the EIS), uniform porosity was applied to each hydrostratigraphic unit as follows:

- Historical MRSA: 0.16
- Organics: 0.19
- Diamicton: 0.2
- Glaciolacustrine: 0.16
- Shallow Bedrock: 0.06
- Upper Bedrock: 0.0001
- Intermediate Bedrock: 0.0001
- Deep Bedrock: 0.0001

d. There is potential for seepage from the MRSAs prior to reaching steady state conditions. The potential for seepage from the MRSAs prior to steady state was identified and characterized in the assessment of effects of the Project on groundwater quality, and subsequently carried through to the assessment of

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effects of the Project on surface water quality. The response to part e. discusses details on the model that was used to predict the wetting time of the MRSAs and the subsequent conservative assumptions of seepage from the MRSAs for operation and closure phases of the Project. The May 2021 supplemental filing then identifies updates undertaken in relation to the re-assessment associated with the MRSA re-design.

e. Mine rock is a relatively unique soil/rock material as it typically comprises the entire spectrum of grain sizes, from clay to boulders. It is generally accepted that there are two main pathways for water flow through the MRSA (i.e., relatively rapid flow through macropores that are present around and between cobbles and boulders and slower capillary-driven flow through micropores).

During operation, as the MRSAs are being built, groundwater recharge primarily results from macropore flow. As part of the site-specific modelling, it has been assumed that 50% of the infiltration will travel rapidly to the base of the pile and recharge groundwater and the remaining 50% will be taken up and stored in the micropore space. Flow will occur in the micropore space at a much slower rate, and eventually the wetting front will reach the base of the pile and the MRSA will be considered to be 'wetted up'. At that point, groundwater recharge is assumed to be 100% of infiltration. Please see Appendix K of the Hydrology Water Balance and Water Quality Impact Assessment: Gordon site - Technical Modelling Report (Volume 5, Appendix D of the EIS) for additional details.

The micropore wetting period was estimated to occur over 25 years at the MacLellan site, 6 years after the MRSA cover is placed, and 31 years at the Gordon site, 19 years after the MRSA cover is placed. The life-of-mine at the Gordon and MacLellan sites is 6 and 13 years, respectively. Therefore, the assumption that recharge will be 50% of the infiltration rate is conservative for operation and for some time after closure.

f. A 100-year dry climate scenario is not appropriate for assessing long-term water quality for pore water volumes. Multiple years are required for recharge to migrate through the MRSA (as presented in Appendix K of the Hydrology Water Balance and Water Quality Impact Assessment: Gordon site - Technical Modelling Report (Volume 5, Appendix D of the EIS). Therefore, the assumption of a sustained period of several years where the precipitation is maintained at the 100-year dry climate conditions is not appropriate to estimate seepage rates from the MRSA.

g. A sensitivity analysis of the groundwater flow model to recharge was completed and is presented in Section 5.4.2.3 of both Volume 5, Appendix F and Volume 5, Appendix G of the EIS.

Sensitivity analyses were conducted to assess the potential effect of an increase or decrease in the future recharge rate on groundwater discharge to the receiving environment. The sensitivity analyses consisted of two scenarios where the recharge rate was adjusted as a 25% increase and a 25% decrease from the calibrated baseline recharge value for each recharge zone. This range was initially selected based on predicted climate change scenarios for Winnipeg, indicating seasonal changes up to 25% from recent conditions. Climate change scenarios presented in the Climate Atlas indicate that the precipitation at Lynn Lake may increase seasonally by up to 20% under the RCP8.5 (high carbon climate future) climate scenario, with an average annual increase of 11% expected for 2051-2080. Assuming that the recharge rate will vary proportionally with precipitation, the

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	range of recharge rates simulated cover the expected range in recharge due to climate change. For the MacLellan site, the relative percent difference in groundwater discharge to watercourses and lakes is less than 20%, and generally less than 10%, when comparing the 25% change in recharge with the calibrated model recharge for the closure scenario. The sensitivity analyses suggest groundwater discharge to Payne Lake, Keewatin River, and Kee3-B2-A1 are sensitive to a 25% decrease in modelled recharge compared to the calibrated model recharge value. For the Gordon site, the relative percent difference in groundwater discharge to watercourses and lakes is less than 8%, and generally less than 3% when comparing the 25% change in recharge with the calibrated model recharge for the closure scenario. The results indicate the groundwater discharge to watercourses and lakes is relatively insensitive to variations in recharge. The effect of dry and wet years on surface water receivers were further evaluated as part of the water balance and water quality models for the MacLellan and Gordon sites as provided in Volume 5, Appendix D and E, of the EIS. **References:** Climate Atlas of Canada. Municipality of Lynn Lake. Available at: https://climateatlas.ca/data/city/38/plus30_2030_85/line
Attachment:	No

RESPONSE TO IAAC-84

ID:	**IAAC-84**
Expert Department or Group:	NRCan-28
Guideline Reference	6.2.2 Changes to Groundwater and Surface Water
EIS Reference	Volume 5, Appendix F Lynn Lake Gold Project, Hydrogeology Assessment – Gordon site Technical Modelling Report 5.4.2.1 Open Pit Filling Table 5-8 Appendix A Map 21
Information Request:	a. Provide a rationale for the larger change in groundwater flux at Marie Lake relative to Farley and Gordon Lakes during the closure phase. i. Describe related uncertainties with regards to the groundwater effects assessment and mitigation, and any monitoring and follow-up that will be implemented to verify the assessment predictions.
Response:	a. As presented in Table 8-8 of Chapter 8 (Volume 1) of the Environmental Impact Statement (EIS), groundwater discharge to Farley Lake, Gordon Lake, and Marie Lake during the closure phase are predicted to be within 61 m^3/day of baseline conditions with the direction of groundwater flow into the lakes consistent with that predicted during baseline conditions. What might appear to be a notable percent difference between baseline and closure groundwater discharge rates is an artifact of slight variations in very low discharge rates. For example, the change in discharge rate between baseline and closure of Marie Lake is less than 0.7 L/s (61 m^3/day). Further, Marie Lake is the deepest lake (maximum depth of 14 m and average depth of 4.5 m) at the Gordon site, compared to Farley and Gordon lakes which are, on average, less than 1.5 m deep making Marie Lake more sensitive to model predictions of groundwater discharge rates. i. The existing data is sufficient for assessing the effects of the Project on groundwater. A variety of sensitivity scenarios were completed throughout the EIS to quantify the uncertainty with model predictions (see the Gordon site Hydrogeology Assessment Technical Modelling Report [Volume 5, Appendix F of the EIS] for sensitivity scenarios related to groundwater predictions). In particular, the uncertainty for groundwater fluxes to lakes to recharge is characterized in Section 5.4.2.3 of this Technical Modelling Report (Volume 5, Appendix F of the EIS) and was found to be relatively insensitive to a 25% increase or decrease in recharge rates. The characterization of bedrock from field data, calibration of the groundwater flow model, and the related sensitivity analysis with respect to groundwater discharge are sufficient to assess the potential effects of the Project on groundwater, particularly with respect to groundwater dischage. A summary of mitigation measures and follow up monitoring are presented in Volume 3 of the EIS, in Chapters 20 and 23, respectively. Follow up monitoring will be completed to confirm the assessment of effects of the Project, which includes confirmation of stream flow (baseflow) in nearby creeks. Based on the assessment of effects of the Project on groundwater and uncertainty analyses, including sensitivity of prediction of effects on groundwater discharge, no

ID:	**IAAC-84**
	additional mitigation measures and/or follow up monitoring are recommended beyond that presented in the EIS. With respect to groundwater and surface water follow up monitoring, this will include quantity (level, pumped volumes, discharge rates) and quality (general chemistry and select dissolved metals) monitoring with an adaptive management component. The adaptive management component will include triggers and thresholds for water quantity and quality that alert to changing conditions and allow flexibility to address/accommodate new circumstances, adjust monitoring, implement new mitigation measures, and/or modify existing measures, if required. Additional information on groundwater and surface water monitoring is provided as well in IAAC-73 and IAAC-108, respectively.
Attachment:	No

RESPONSE TO IAAC-85

ID:	**IAAC-85**
Expert Department or Group:	NRCan-29
Guideline Reference	6.1.5 Groundwater and Surface Water
EIS Reference	8.2.2.3 Estimation of Hydraulic Conductivity Volume 5, Appendix G Lynn Lake Gold Project, Hydrogeology Assessment - MacLellan site Technical Modelling Report 4.3.2 Recharge
Information Request:	a. Indicate what hydraulic testing data has been collected for the NSZ fault zone. b. Describe the potential impact of a higher hydraulic conductivity fault zone on assessment results. i. Indicate if additional monitoring and follow-up will be implemented to verify the assessment predictions as well as additional mitigation measures that may be required as part of an adaptive management plan.
Response:	a. Alamos understands that there is a discrepancy regarding the characterization of the NSZ. The discrepancy stems from the development of the groundwater flow model prior to the packer testing of deep geotechnical boreholes at the MacLellan site. Although the packer testing data was used to confirm and/or refine the MacLellan groundwater flow model, the text in the groundwater modelling report was not updated to reflect this updated data. The east-west trending NSZ is mapped through the open pit at the MacLellan site. Packer testing was completed on four deep geotechnical boreholes. Two of these boreholes intersected fault zones. GTM-15-03 passed through two fault zones in the interval of 36.7 m to 59.4 m along the borehole and corresponded with an estimated hydraulic conductivity of 1x10^{-7} m/s. GTM-15-03 passed through a shear zone from 24.7 m to 41.4 m along the borehole and corresponded with an estimated hydraulic conductivity of 2.4x10^{-7} m/s. The hydraulic conductivity estimated for the fault and/or shear zones were consistent with hydraulic conductivity results for packer testing completed on the surrounding bedrock within the same borehole and the other deep geotechnical boreholes at the MacLellan site. Therefore, the NSZ was not delineated as a separate hydrostratigraphic unit within the MacLellan site groundwater flow model. Results of the deep bedrock geotechnical borehole packer tests are tabulated in Table 2B of the Hydrogeology Baseline Technical Data Validation Report (Volume 4, Appendix H of the Environmental Impact Statement [EIS]). b. The field data supports the characterization and parameterization of hydrostratigraphic units in the groundwater flow model as hydraulic testing of bedrock does not identify variation in hydraulic conductivity between the fault and/or shear zones and surrounding bedrock. In addition, a sensitivity analysis was completed to evaluate uncertainty related to bedrock hydraulic conductivity to groundwater flow model predictions and is presented in Section 5.3.2.2 of the MacLellan site Hydrogeology Assessment Technical Modelling Report (Volume 5,

ID:	**IAAC-85**
	Appendix G of the EIS). The existing data and characterization is sufficient for assessing the effects of the Project on groundwater. i. The characterization of the fault presented in the EIS and in response to this comment are sufficient to assess the potential effects of the Project on groundwater. The mitigation measures and follow up monitoring presented in Volume 1, Chapter 8, Sections 8.4 and 8.9, of the Environmental Impact Statement (EIS) are sufficient to confirm the assessment of effects to groundwater and no additional mitigation measures and/or follow up monitoring are recommended. Specifically, measuring pumped volumes from the open pit relative to simulated pumped volumes and measuring water levels compared with simulated water levels will be used to confirm the predicted effects of the Project on groundwater with respect to hydraulic conductivity of bedrock. As described in detail in the response to IAAC-73, groundwater follow up monitoring will include groundwater quantity (level, pumped volumes) and quality (general chemistry and select dissolved metals) monitoring with an adaptive management component. The adaptive management component will include triggers and thresholds for groundwater quantity and quality that alert to changing conditions and allow flexibility to address/accommodate new circumstances, adjust monitoring, implement new mitigation measures, and/or modify existing measures, if required.
Attachment:	No

RESPONSE TO IAAC-86

ID:	**IAAC-86**
Expert Department or Group:	NRCan-30
Guideline Reference	6.1.5 Groundwater and Surface Water
EIS Reference	Volume 5, Appendix G Lynn Lake Gold Project, Hydrogeology Assessment - MacLellan site Technical Modelling Report 4.3.2 Recharge 4.4.4 Calibrated Model Parameters Table 4-3 Appendix A Map 5
Information Request:	a. Provide maps showing the simulated surficial geology for each site at a LAA scale. b. For the MacLellan site, describe whether the 120 mm per year of groundwater could be recharged throughout the model (as evidenced by the water balance results, and the locations where the groundwater table exceeds the ground surface elevation).
Response:	a. Maps showing the simulated surficial geology for the MacLellan and Gordon local assessment areas (LAAs) are provided as an attachment to this response (see Maps IAAC-86-1 and IAAC-86-2). b. For the MacLellan site, a groundwater recharge rate of 120 mm per year (3.8×10^{-9} m/s) was applied compared to the lowest hydraulic conductivity of the simulated surficial geology of $8.3\text{x}10^{-6}$ m/s (glaciolacustrine sediment). The recharge rate is more than 3 orders of magnitude lower than the lowest hydraulic conductivity to which the recharge was applied directly. The surficial hydrostratigraphic units, therefore, have sufficient hydraulic conductivity to accept the recharge across the model domain.
Attachment:	Appendix A, Attachment IAAC-86

RESPONSE TO IAAC-87

ID:	**IAAC-87**
Expert Department or Group:	NRCan-32
Guideline Reference	4.3 Study strategy and methodology
EIS Reference	Volume 5, Appendix G Lynn Lake Gold Project, Hydrogeology Assessment - MacLellan site Technical Modelling Report 5.2.1.3 Tailings Management Facility
Information Request:	a. Provide a schematic cross-section showing the configuration of the tailings, high density polyethylene liner, and dam rock fill within the numerical model. i. Include the thickness of the numerical layer along with the design thickness of each material. ii. Label the materials with the hydraulic conductivity applied in the model.
Response:	a. i. and ii. A schematic cross-section showing the configuration of the tailings management facility, as built in the MacLellan groundwater flow model (Volume 5, Appendix G of the Environmental Impact Statement) is provided as an attachment to this response (see Figure IAAC-87-1).
Attachment:	Appendix A, Attachment IAAC-87

RESPONSE TO IAAC-88

ID:	**IAAC-88**
Expert Department or Group:	NRCan-33
Guideline Reference	6.2.2 Changes to groundwater and surface water
EIS Reference	Volume 5, Appendix G Lynn Lake Gold Project, Hydrogeology Assessment - MacLellan site Technical Modelling Report 5.2.2.1 Starter Pit Dewatering Table 5-3
Information Request:	a. Update the groundwater model where possible, by changing numerical solver settings to improve model stability, such that changes in flux being assessed are greater in magnitude than the numerical artifacts of the model. i. Where improvements to model stability result in changes to assessment results, update the effects assessment as appropriate. ii. If improvements to model stability cannot be achieved, provide justification as to why, and provide a rationale for why current model results are satisfactory.
Response:	a. The Standard Iterative PCG numerical solver was used with a head tolerance of 0.0002 m for the groundwater modelling. This solver showed overall good model stability, in spite of some changes in flux that were greater in magnitude than the numerical artifacts of the model. In general, the magnitude of the numerical artifacts of the model do not affect the conclusions on groundwater influence on surface water flows. No update to the effects assessment is required. i and ii. Response provided in a. above.
Attachment:	No

RESPONSE TO IAAC-89

ID:	**IAAC-89**
Expert Department or Group:	NRCan-34
Guideline Reference	4.3 Study strategy and methodology
EIS Reference	Volume 5, Appendix G Lynn Lake Gold Project, Hydrogeology Assessment – MacLellan site Technical Modelling Report 5.3.1.2 Mine Rock Storage Area and Tailings Management Facility 5.3.1.3 Seepage Collection System Appendix A Map 3
Information Request:	a. Describe the changes made to the TMF boundary at the end of operations. Include the top elevation of the tailings, and the applied recharge boundary. b. Provide a map showing the locations of the boundaries applied to represent the seepage collection system. Note which nodes actively remove water from the model in both operations and closure phases.
Response:	a. Within the MacLellan groundwater flow model, the tailings management facility (TMF) constant head boundary was removed and the total recharge into the TMF was adjusted to 83.95 mm/year to maintain a tailings pond at the top of the tailings surface at the end of the operation phase. The top elevation of the tailings was defined as 374 m above mean sea level. b. The seepage collection system along the exposed perimeter of the TMF and mine rock storage area (MRSA) was simulated in the MacLellan site groundwater flow model for operation and closure phases using a seepage face boundary condition, based on a series of 2 m deep ditches. The seepage face boundary condition allows the nodes to drain passively (i.e., no active removal of water into the drain). The results of the groundwater flow modelling indicate some portions of the seepage collection ditches are more effective at intercepting a portion of groundwater seepage from the TMF and MRSA, as the water table is below the base of the seepage collection ditches in several locations in the upland area. The attached figure (Figure IAAC-89-1) highlights the portions of the seepage collection ditches at the MacLellan site where the ditches are simulated to intercept a portion of groundwater seepage from the TMF and MRSA. The groundwater seepage that will be intercepted in the locations as shown will be intercepted throughout operation and closure. Water reporting to the ditches will be actively managed (e.g., pumped back into the TMF) during Project operation. During closure, the water will be initially managed until such time that it is of a quality that it can be released to the environment, see Conceptual Closure Plan (CCP; Appendix 23B of the EIS).
Attachment:	Appendix A, Attachment IAAC-89

RESPONSE TO IAAC-90

ID:	**IAAC-90**
Expert Department or Group:	NRCan-35
Guideline Reference	6.2.2 Changes to groundwater and surface water
EIS Reference	Volume 5, Appendix G Lynn Lake Gold Project, Hydrogeology Assessment – MacLellan site Technical Modelling Report 5.2.2.1 Starter Pit Dewatering 5.4.2.1 Open Pit Filling Appendix A Maps 15, 24, 25 and 26
Information Request:	a. Provide updated Maps 15, 24, 25, and 26 to show model results that are consistent with the text description.
Response:	a. Maps 15, 24, 25, and 26 from the MacLellan site Hydrogeology Assessment Technical Modelling Report (Volume 5, Appendix G of the Environmental Impact Statement) have been updated and are provided as an attachment to this response (Maps IAAC-90-1 to IAAC-90-5). The maps are consistent with the description provided in the Technical Modelling Report.
Attachment:	Appendix A, Attachment IAAC-90

RESPONSE TO IAAC-91

ID:	**IAAC-91**
Expert Department or Group:	NRCan-36
Guideline Reference	6.2.2 Changes to groundwater and surface water
EIS Reference	Volume 5, Appendix G Lynn Lake Gold Project, Hydrogeology Assessment – MacLellan site Technical Modelling Report 5.3.2.1 Open Pit Dewatering Table 5-5
Information Request:	a. Describe how the boundaries for the East Pond and KEE3-B2-A1 are modified during operations. b. With the drainage of East Pond, describe the likelihood for its outlet to continue to flow. c. If KEE3-B2-A1 is likely to be drained during operations, provide an updated groundwater model and effects assessment. d. Indicate any monitoring and follow-up that will be implemented to verify assessment predictions as well as additional mitigation measures required as part of an adaptive management plan.
Response:	a. The flow boundaries of East Pond and Kee3-B2-A1 were not altered during operation within the MacLellan groundwater flow model. b. East Pond is anticipated to be dewatered during operation due to the lowering of the water table by up to 5 m and the loss of catchment due to the open pit development. As presented in the MacLellan Hydrogeology Assessment Technical Modelling Report (Volume 5, Appendix G of the Environmental Impact Statement [EIS]), groundwater discharge at KEE3-B2-A1 is anticipated to be affected as a result of the Project. KEE3-B2-A1 will still have a component of flow as 64% of the catchment will remain after the Project is developed, however, for the purpose of the assessment of the effects of the Project on fish and fish habitat, it was conservatively assumed the entire length of KEE3-B2-A1 would dry up. c. As presented in the response to b., to be conservative, the assessment of effects was carried out with the assumption that KEE3-B2-A1 would dry up. d. A summary of mitigation measures and follow up monitoring are presented in Volume 3 of the EIS, Chapters 20 and 23, respectively. Follow up monitoring will be completed to confirm the assessment of effects of the Project. With respect to groundwater and surface water, follow up monitoring will include quantity (level, pumped volumes, stream flow) and quality (general chemistry and select dissolved metals) monitoring with an adaptive management component. The adaptive management component will include triggers and thresholds for groundwater and surface water quantity and quality that alert to changing conditions and allow flexibility to address/accommodate new circumstances, adjust monitoring, implement new mitigation measures, and/or modify existing measures, if required. Additional information on groundwater and surface water monitoring is provided as well in IAAC-73 and IAAC-108, respectively. With respect to KEE3-B2-A1, the assessment of effects was carried out with the prediction that KEE3-B2-A1 would dry up during operation. This assessment

ID:	**IAAC-91**
	prediction will be confirmed with a stream gauge and periodic visual inspections during the life of the Project.
Attachment:	No

RESPONSE TO IAAC-92

ID:	**IAAC-92**
Expert Department or Group:	NRCan-37
Guideline Reference	4.3 Study strategy and methodology 6.1.2 Geology and geochemistry
EIS Reference	Volume 4, Appendix F Geochemistry Baseline Technical Data Report 3.0 Methods Appendix F Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. MEND Report 1.20.1. Mining Environment Neutral Drainage Program, Natural Resources Canada; MEND (2009)
Information Request:	a. Provide cross-sections or block model images that show the location of all mine rock and ore samples from both Gordon and MacLellan deposits. Clearly show: i. the borehole traces, geology surfaces, ore zones, the anticipated location of the open pit, the location of the historic mine workings, and a legend to allow for interpretation of these images; and ii. all sample locations from both deposits in order to verify spatial representativeness of the samples. b. Provide a review of sample heterogeneity with respect to mineralogy and sample observations in the field, to justify the short sample interval utilized in this study. c. Provide tonnage estimates for each lithology from both the Gordon and MacLellan deposits and quantitative justification for the number of samples collected in consideration of the initial sampling frequency provided in MEND, 2009. The waste rock tonnages must reflect the most up-to-date mine plan.
Response:	a. The cross sections of block models for both the Gordon and MacLellan deposits are provided in Figures IAAC-92-1a through IAAC-92-1m and IAAC-92-2a through IAAC-92-2n, respectively, which are attached to this response. These files contain the information requested under a. i. and ii. b. An one-meter sample interval was consistent with the interval Alamos used for sampling and testing for gold. This sample interval is suitable for evaluating the variability in chemistry and mineralogy of materials. Longer sample intervals or compositing samples may mask significant variability in material properties as indicated on page 8-9 of MEND Manual (2009). Samples for the acid rock drainage (ARD)/metal leaching (ML) assessment were selected based on visual descriptions, including carbonate and sulfide content as provided in Appendix C of the 2015/2016 Geochemistry Baseline Program report (Volume 4, Appendix F of the Environmental Impact Statement). c. Figures IAAC-92-1c and IAAC-92-2c attached to this response include tables showing tonnage estimates and numbers of samples tested for each lithology to build the ARD block models for the Gordon and MacLellan site deposits. These tables clearly indicate that the number of tested samples for each lithology satisfies the criteria provided in Table 8-2 of MEND Manual (Price 2009).
Attachment:	Appendix A, Attachment IAAC-92

RESPONSE TO IAAC-93

ID:	**IAAC-93**
Expert Department or Group:	ECCC-33
Guideline Reference	6.1.2 Geology and geochemistry
EIS Reference	Volume 4, Appendix F Geochemistry Baseline Technical Data Report 4.2.2 Gordon site
Information Request:	a. Provide clarity on the amount of sulphides and carbonates contained in the ore and tailings from both the Gordon and MacLellan sites and/or rationale for why the Gordon tailings are expected to have a similar amount of sulphides, when the amount of sulphides in the ore is higher.
Response:	a. The apparent differences in the amount of sulfides are potentially attributable to: • The different mineralogical compositions of the ore (FL ORE and ML ORE) and tailings (CND4 and CND 3P) samples. • The difference in the results between the laboratories because ore samples were tested by ALS while tailings samples were tested by SGS laboratories. • The error of XRD analysis at mineral content below 5%. Better estimates of sulfide content in the Gordon site ore can be made from Table 4.3-5 (in Volume 4, Appendix F of the Environmental Impact Statement), which provide chemistry summaries for individual samples. Overall, the average sulfide sulfur content in ore is 3.5 wt.% (n=28, SD=3.5) and in tailings it is 1.9 wt.% (n=17, SD=1.2). Sulfide sulfur content in ore and tailings is not different based on unpaired t-test at 95% confidence level.
Attachment:	No

RESPONSE TO IAAC-94

ID:	**IAAC-94**
Expert Department or Group:	ECCC-34
Guideline Reference	6.1.2 Geology and geochemistry
EIS Reference	Volume 4, Appendix F Geochemistry Baseline Technical Data Report / Validation Report 4.3.2.2 Mine Rock
Information Request:	a. Provide rationale for the mine rock lithology groupings. b. Provide rationale as to whether the grouping of mafic and ultramafic rocks with igneous rocks may influence the ability to detect ARD/ML. i. If the groups are found to mask the ability of tests to detect ARD/ML, update the assessment of effects, as necessary.
Response:	a. The lithology groupings were purposely made broad enough to capture important differences based on rock origin (igneous vs. sedimentary) and spatial distribution (argillite unit vs. BIF+mafic sediments), but not so broad as to mask the ability to detect acid rock drainage (ARD). It should be noted that there have been relogging campaigns during the baseline geochemistry data collection. As a result, lithocodes for some of the samples were revised (e.g., some granodiorite:I1b samples became dacite:V1); however, these samples remained within the lithologic group. This fact indicates that the rationale for the initial grouping is valid. b. Sulfide sulfur content has been compared between 1) gabbro (mafic) and pyroxenites (ultra-mafic) and 2) the rest of the lithologies from the igneous group. The average sulfide sulfur content in the gabbro and pyroxenites (mean =0.116 wt.%, SD=0.145, n=5) is not significantly different from the average sulfide sulfur content in the igneous rock group (mean =0.268 wt %, SD=0.358, n=59) based on an unpaired t-test at 95% confidence level. Similarly, the difference between the averages of neutralization potential values between the two groups is not statistically significant. These comparisons demonstrate that the key inputs for calculation of NPR, and estimation of ARD potential, are not different between the two groups. Therefore, combining mafic and ultra-mafic rock in the overall igneous group together does not mask the ability to detect ARD potential. No update to the effects assessment is therefore warranted. i. Response provided in b. above. No update to the assessment of effects is necessary.
Attachment:	No

RESPONSE TO IAAC-95

ID:	**IAAC-95**
Expert Department or Group:	NRCan-38
Guideline Reference	6.1.2 Geology and geochemistry 6.2.2 Changes to groundwater and surface water
EIS Reference	Volume 4, Appendix F Geochemistry Baseline Technical Data Report 3.4.2 Characterization of Composite Samples 3.4.3 Kinetic Tests Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. MEND Report 1.20.1. Mining Environment Neutral Drainage Program, Natural Resources Canada; MEND (2009)
Information Request:	a. Provide the static test data for all kinetic test samples. b. Provide a rationale for the selection of kinetic test samples including a detailed quantitative review of the representativeness of each kinetic test sample with respect to the material type/lithology that they represent and parameters of interest with respect to ARD/ML (ABA, trace metal, shake flask extraction for parameters of interest including but not limited to NP, total Sulphur, neutralization potential ratio, silver aluminum, arsenic, cadmium, copper, fluoride, molybdenum, nickel, lead, selenium and uranium).
Response:	a. The key acid base accounting parameters, such as total sulfur, NP, and neutralization potential ratio are shown in Table 3.5-2 (in Volume 4, Appendix F of the Environmental Impact Statement [EIS]). Appendix D in Volume 4, Appendix F of the EIS contains the static test data, including acid base accounting, total metal content, shake flask results, and other tests carried out for composite samples. b. Tables IAAC-95-1 to IAAC-95-6 provided with this response allow comparison of statistics for the parameters measured in individual and composite samples used for kinetic tests. The summary tables for the MacLellan site indicate that: • At least one composite sample from each material has equal or lower NPR (Net Potential Ratio) value than the ratio of average NP (Neutralization Potential) /average AP (Acid generation Potential) in that material. • For total aluminum, arsenic, cadmium, copper, fluoride, molybdenum, nickel, lead, selenium, silver and uranium, at least one composite sample from each material has equal or greater value than the median with a few exceptions. The exceptions are as follows: – In overburden: arsenic and selenium. – In ore: cadmium, copper, nickel, selenium, and uranium. Note that the composite sample ML (MacLellan) ORE is a blend of high and low grade ores and this sample was conservatively compared to high grade ore statistics of individual samples in Table IAAC-95-3. The summary tables for the Gordon site indicate that: • At least one composite sample from each material/lithogroup has equal or lower NPR value than the ratio of average NP/average AP in that material/ lithogroup.

ID:	**IAAC-95**
	• For total aluminum, arsenic, cadmium, copper, fluoride, molybdenum, nickel, lead, selenium, silver and uranium, at least one composite sample from each material has equal or greater value then the median with a few exceptions. The exceptions are as follows: – In argillite (FL S2c): selenium and uranium. – In ore: selenium and cadmium. Similar to the MacLellan ore, composite sample FL (Farley Lake now [Gordon site]) ORE is a blend of high and low grade ores and this sample constituted a conservative comparison with high grade ore statistics of individual samples in Table IAAC-95-6. Based on the summaries provided above, the composite samples selected for kinetic tests are considered representative and appropriate for providing input to predictions of the upper-case scenario.
Attachment:	Appendix A, Attachment IAAC-95

RESPONSE TO IAAC-96

ID:	**IAAC-96**
Expert Department or Group:	NRCan-39
Guideline Reference	6.1.2 Geology and geochemistry
EIS Reference	Volume 4, Appendix F Geochemistry Baseline Technical Data Report 3.0 Methods
Information Request:	a. Provide the tabulated NAG test results along ABA data. b. Describe the NAG methods used and approach to data evaluation, and provide a detailed review of how the NAG test results compare with the ARD potential determined through ABA tests.
Response:	a. Net Acid Generating (NAG) tests were conducted on tailings samples and composite samples of rock and ore. Tabulated results of the NAG tests are presented in Table IAAC-96-1 accompanying this response. b. The NAG method is described in Section 3.4.1 (page 8) of Volume 4, Appendix F of the Environmental Impact Statement. The Net Potential Ratios (NPR) were plotted against NAG pH to compare acid rock drainage (ARD). See Figures IAAC-96-1 to IAAC-96-3 attached to this response. Using NAG test criteria, a sample would be classified as Potentially Acid Generating (PAG) if NAG pH is below 4.5. A plot for individual tailings samples shows that all samples with acidic pH have carbonate NPR values below 0.5. In contrast, the conservative assumption was made in the ARD assessment based on acid base accounting data that materials with NPR below 2 may have the risk of ARD. This comparison indicates that ARD potential derived through acid base accounting tests (NPR) is more conservative than through NAG pH tests. As a result, the decision was made to omit discussion of NAG tests to avoid confusion in the interpretation of the ARD potential.
Attachment:	Appendix A, Attachment IAAC-96

RESPONSE TO IAAC-97

ID:	**IAAC-97**
Expert Department or Group:	NRCan-40
Guideline Reference	6.1.2 Geology and geochemistry
EIS Reference	Volume 4, Appendix F Geochemistry Baseline Technical Data Report 3.0 Methods, 4.6 ARD Block modelling results Geochemical Baseline Technical Data Validation Report 2.0 Existing Data
Information Request:	a. Provide a detailed validation of the block model using the baseline geochemistry data as well as the feasibility of waste segregation using a sulphur cut-off of 0.11 weight % both in terms of the physical segregation of materials as well as mine sequencing. b. Provide a list of parameters included in the multi-elements scan and justification for why this was not included in the block model to evaluate zones of elevated metal content.
Response:	a. The baseline geochemistry data are already included as inputs to the block model. Therefore, the block model cannot be formally validated by the method proposed by NRCan. Validation of the Acid Rock Drainage block model is most appropriately accomplished by additional sampling and testing of blast hole cuttings. The testing of blast hole cuttings for multielement analysis, including sulfur, will provide basis for classification of mine block prior to excavation. If the average sulfur content in the block is below 0.11% a block would be classified as non-Potentially Acid Generating (non-PAG). Otherwise, field (Net Potential Ratios [NPR]) values will be calculated from multielement analysis to classify the mine block. The mine sequencing of PAG materials is currently being evaluated and will be addressed in the Acid Rock Drainage and Metal Leaching (ARD/ML) Management and Monitoring Plan. Preliminary results descussing mine rock sequencing and feasibility of PAG rock management at an operational level is discussed in the response to IAAC-99 part c. b. The multi-element scan included the following parameters: S Hg As Al Ag B Ba Be Bi Ca Cd Co Cr Cu Fe K Li Mg Mn Mo Na Ni P Pb Sb Se Sn Sr Th Ti Tl U V W Y Zn The block models for trace elements were not built because the water quality models showed that none of the parameters will exceed the Metal and Diamond Mining Effluent Regulation (MDMER) discharge limits and/or acute/short-term federal and provincial guidelines in discharges from either site for the Expected and Upper Cases (Volume 5, Appendices E and D of the Environmental Impact Statement). The results of the modelling are consistent with multi-year monitoring of historical features and leachates from field bins. Therefore, it was concluded that the block models and mitigation of ML from mine rock is not needed, except for activities outlined in the Conceptual Closure Plan (Appendix 23B of the EIS). As indicated in part a. of this response, the ARD/ML Management and Monitoring

ID:	**IAAC-97**
	Plan will consider adaptive management in situations where concentrations in contact water start approaching the thresholds (e.g., MDMER limits). Management and monitoring plans will describe (as applicable) the location of interventions, planned protocols, lists of measured parameters, analytical methods employed, schedule, resources required as well as parameters to be monitored, methodology and equipment to be used, frequency, duration of monitoring, adaptive management triggers/thresholds, and reporting requirements. Finalization of management and monitoring plans will occur during the permitting stage of Project planning (i.e., following receipt of a federal Decision Statement for the Project under CEAA 2012 and provincial licences for the Project under *The Environment Act* of Manitoba) and will be completed prior to the start of Project construction.
Attachment:	No

RESPONSE TO IAAC-98

ID:	**IAAC-98**
Expert Department or Group:	NRCan-41
Guideline Reference	6.1.2 Geology and geochemistry 6.2.2 Changes to groundwater and surface water
EIS Reference	Volume 4, Appendix F Geochemistry Baseline Technical Data Report 4.0 Results Geochemical Baseline Technical Data Validation Report 3.3 Monitoring of Historical Features 3.4 Validation Summary
Information Request:	a. Provide a comparative evaluation of the geology, mineralogy, and ARD/ML potential of the historic waste and future waste. i. Include consideration of historic and current geology, mineralogy, and geochemical data and observations, the ARD block model, as well as include block model images or cross sections that clearly distinguish between the historically mined rock and the future mine rock to developed in the open pits. ii. If differences exist between the historically mined rock and the future mine rock, update the effects assessment with this information or provide a rationale for why water quality associated with historic mine workings is an appropriate proxy for future mine rock.
Response:	a. i. The geology and mineralogy of the historical mine rock is comparable to the future mine rock based on available information from the previous mining and exploration reports. The geochemistry data of samples from historical mine rock piles is summarized in Table IAAC-98-1 attached to this response. • On average, the chemistry of the MacLellan site historical mine rock is not statistically different from the future rock, except for As, Cd and Zn. The total concentrations of these parameters in the MacLellan site historical mine rock are higher, implying that contact water quality for the future mine rock should be better than the contact water currently generated by the historical mine rock. • The Gordon site mine rock has higher average Acid Potential (AP) and carbonate Neutralization Potential (CarbNP) values than the future mine rock, but statistically similar AP/NP ratios showing the same acid rock drainage (ARD) potential. Total concentrations of several trace elements (Cr, Ni, Pb, Sb, Se, U, V, and Zn) are higher in the future mine rock at the Gordon site. However, this should not change the results of the assessment because the predicted future seepage quality from the mine rock was based on kinetic tests of future mine rock as mentioned below in part ii. of this response. • The ARD block models that show the historical mine workings (underground mine-outs) and pits are provided in response to IAAC-92. ii. The water quality of the mine workings, as well as other observed water quality, was not used for predicting future contact water quality. Instead, kinetic tests scaled to full size features were used as inputs to predict future contact water quality water. The methodology for predicting future contact water quality

ID:	**IAAC-98**
	is presented in the water quantity and quality modelling reports (Volume 5, Appendices E and D of the Environmental Impact Statement). Because the chemistry of the future mine rock is similar to the historical mine rock, an update of the assessment of the effects as requested in this IR is not deemed to be warranted.
Attachment:	Appendix A, Attachment IAAC-98 (and see Attachment IAAC-92)

RESPONSE TO IAAC-99

ID:	**IAAC-99**
Expert Department or Group:	NRCan-42 ECCC-36
Guideline Reference	2.2 Alternative means of carrying out the project 6.1.2 Geology and geochemistry 6.2.2 Changes to groundwater and surface water
EIS Reference	Volume 4, Appendix F Geochemistry Baseline Technical Data Report Geochemical Baseline Technical Data Validation Report 4.0 Closure Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. MEND Report 1.20.1. Mining Environment Neutral Drainage Program, Natural Resources Canada; MEND (2009)
Information Request:	a. Provide additional justification for the use of existing mine waste contact water as a proxy for future contact water, particularly in light of the review of sample representativeness requested in IAAC-60. b. Provide a plan to conservatively evaluate the long-term ARD potential of the argillite unit, including timing to the depletion of buffering capacity and the onset of acidic leachate as well as ML potential associated with acidic drainage. Consider the evaluation of the kinetic behaviour of blended future mine waste to demonstrate the potential that buffering capacity from other materials is successful at preventing the development of acidic drainage from the argillite and MacLellan mine rock. c. Provide an evaluation of options for mine waste management to minimize ARD/ML at both Gordon and MacLellan sites in consideration of the differing geology at both sites, planned mine sequencing, and practicality at the operations level. i. Indicate the preferred option and provide supporting rationale. ii. Provide a detailed description of how blending of mine rock will be undertaken and how it is anticipated to avoid hot spots and prevent potential ARD/ML from the MRSAs.
Response:	a. We cannot find the request for sample representatives in IAAC-60. Historical water quality, as well as leachates from unscaled tests were used for qualitative assessment of acid rock drainage/metal leaching (ARD/ML) potentials. The method used to predict future contact water quality is presented in the water quantity and quality modelling reports (Volume 5, Appendices D and E of the Environmental Impact Statement) and is based on static and kinetic testing results of the future mine rock. b. The conservative estimate of depletion of buffering capacity for the argillite unit is 3 years based on a Neutralization Potential (NP) depletion rate of 25 $CaCO_3$ mg/kg/week and a minimum NP of 4.2 $CaCO_3$ kg/t as measured in potentially acid generating (PAG) samples (see Figure IAAC-99-1). The kinetic behavior of blended future mine waste is evaluated in Attachment IAAC-99. c. Attachment IAAC-99 provides an evaluation of options for mine waste management to reduce ARD/ML at both the Gordon and MacLellan sites and considers geology, planned mine sequencing, and operational practicality. This

ID:	**IAAC-99**
	attachment discusses the rationale for the preferred options for each site and provides a description of mine rock blending to limit the size of hot spots and reduce potential for ARD/ML.
Attachment:	Appendix A, Attachment IAAC-99

RESPONSE TO IAAC-100

ID:	**IAAC-100**
Expert Department or Group:	NRCan-43
Guideline Reference	6.1.2 Geology and geochemistry
EIS Reference	Volume 4, Appendix F Geochemistry Baseline Technical Data Report 4.0 Results Geochemical Baseline Technical Data Validation Report
Information Request:	a. Provide an evaluation of the potential for the development of NMD, mine rock lithologies that are associated with higher potential, and zones within the two deposits that may contain waste with higher potential to develop NMD. i. Include consideration of the practicality of segregating waste with high NMD potential. ii. If there is a potential for the development of NMD, update the effects assessment for water and describe any changes in the conclusions. Indicate if additional mitigation measures are required.
Response:	a. i. and ii. The requested evaluation has already been conducted and the results presented in the water quality modelling reports (Volume 5, Appendices D and E of the Environmental Impact Statement). The predicted concentrations of nitrogen species and typical neutral mine drainage (NMD) trace elements were generated using the water quality models. These predictions show that none of the parameters will exceed the MDMER discharge limits and/or acute/short term federal and provincial guidelines in both the Expected and Upper cases. Therefore, there is no plan for segregating mine rock with high NMD potential and an update of the effects assessment for water quality is not required.
Attachment:	No

RESPONSE TO IAAC-101

ID:	**IAAC-101**
Expert Department or Group:	NRCan-44
Guideline Reference	6.1.2 Geology and geochemistry
EIS Reference	Volume 4, Appendix F Geochemistry Baseline Technical Data Report 3.3.1 Solid Samples Appendix C Geochemical Baseline Technical Data Validation Report 4.0 Closure
Information Request:	a. Confirm if overburden samples were collected at MacLellan site and provide a table summarizing the descriptions for these samples, similar to the one presented in Appendix C. i. If samples were not collected, provide justification for why overburden from Gordon site is considered a reasonable proxy. ii. Indicate any related uncertainty in regards to potential effects and mitigation, and what monitoring and follow-up will be implemented to verify assessment predictions as well as additional mitigation measures required as part of an adaptive management plan. b. Provide a map showing the locations of all overburden samples relative to the historic mine workings, proposed mine development, and surficial geology at both the Gordon and MacLellan sites.
Response:	a. Overburden samples were collected at the MacLellan site as discussed in Section 4.4.1.1 in Volume 4, Appendix F of the Environmental Impact Statement (EIS). Sample descriptions are then provided in Appendix C of Volume 4, Appendix F of the EIS (starting on page C-M-4). i. Response provided under a. above. Samples were collected. ii. Response provided under a. above. Most of the overburden at the MacLellan site is glacial till and lacustrine/fluvial deposits, which originates from distant locations (based on the glacial history of the site) and was not generated from the weathering of Project ore deposits. The results of overburden testing are discussed in Sections 4.3.1.1, 4.4.1.1 and 4.5.3.1 in Volume 4, Appendix F of the EIS and the related uncertainty statistics are presented in Tables 4.3-5 through 4.3-7 in Volume 4, Appendix F of the EIS. Overburden has a low ARD/ML potential as concluded in Section 5.1 of Appendix F of the EIS. Contact water from the overburden storage areas will be gravity-drained towards collection sumps and pumped to the collection pond as discussed in Volume 1, Chapter 9, Section 9.4.1.3 of the EIS. The collection pond will be monitored to comply with the applicable discharge limits and options for treatment will be determined if monitoring indicates exceedances of these limits. If the need for treatment is identified, monitoring of the overburden stockpile will be included with other sources discharging to the collection pond. This will address any uncertainty associated with the ARD/ML potential of the overburden as assessed and discussed in the EIS and supporting documentation.

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	b. Locations of drillholes with overburden samples are provided in Tables IAAC-101-1 and IAAC-101-2 and Maps IAAC-101-1 and IAAC-101-2 attached to this response.
Attachment:	Appendix A, Attachment IAAC-101

RESPONSE TO IAAC-102

ID:	**IAAC-102**
Expert Department or Group:	ECCC-35 MMF-13 NRCan-45
Guideline Reference	6.1.2 Geology and geochemistry 6.2.2 Changes to groundwater and surface water 6.6.1 Effects of potential accidents or malfunctions
EIS Reference	22.5.1 Tailings Management Facility Malfunction Volume 4, Appendix F Geochemistry Baseline Technical Data Report Geochemical Baseline Technical Data Validation Report
Information Request:	a. Provide a detailed summary of the method used to determine the timing to onset of acidic conditions in the tailings samples, including a comparative evaluation of the timing based on samples considered most representative of future tailings to be managed in the facility and thus generating seepage. Include expectations for process water quality and how this will influence seepage quality with respect to ARD/ML and cyanide. b. Describe why there will be no development of ARD during operations. c. Provide a review of the management options for tailings and the TMF being considered and how they address the potential for ARD/ML and seepage containing elevated cyanide, during all phases of the Project. i. Indicate the preferred option and provide supporting rationale. d. Provide detailed plans for closure of the TMF including sourcing and use of appropriate materials so that infiltration and seepage is managed.
Response:	a. The detailed description of the method to estimate the onset of acidic conditions or Neutralization Potential (NP) depletion time is provided in Volume 4, Appendix F, Section 3.5.1.3 of of the Environmental Impact Statement (EIS). The calculations of acid rock drainage (ARD) onset time for tailings are provided in Table IAAC-102-1 attached to this response. The composition of tailings will change depending on ore feed, but the most relevant samples are the master composite sample (CND 2P) and composite MacLellan tailings samples (CND 5 and CND2P), representing the surface of the tailings at closure. The ARD onset time for these samples ranges from 30 to 32 years, which is beyond the planned closure of the facility. Process water quality is represented by day 0 of ageing tests (see Volume 4, Appendix F, Table 4.4-4 of the EIS) and the assessment provided in the second paragraph of Section 5.4 in this Technical Report. The predictions of seepage quality are influenced by tailings management facility (TMF) pond water and the chemistry of leachates from subaqueous column tests as described in the MacLellan site water quantity and quality modelling report (Volume 5, Appendix D of the EIS). b. The minimum ARD onset time is eight years as presented in Table IAAC-102-1 attached with this response. During operation, deposited tailings will be constantly buried with the fresh slurry coming from the processing plant and will not be exposed to atmospheric oxygen for at least eight years. In addition, the pH of the TMF decant pond will be controlled by the process plant through regulation of pH during the cyanide destruction process prior to slurry discharge. Therefore, because tailing will be saturated during operation, and because there is excess alkalinity in the tailings decant water, no development of ARD is expected in the TMF during operation.

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	c. The rationale for selected management of ARD/ML and potential elevated cyanide in seepage from tailings is based on the test results discussed in Volume 4, Appendix F, Section 5.4 of the EIS. The following potential options to manage seepage from tailings during all phases of the Project were evaluated: • Seepage reduction using dry stack tailings deposition: This option was not feasible for the Project due to high operational costs associated with transport, placement, and compaction of the tailings, and the technical challenges associated with achieving required compaction of tailings for stability of the stack in a net precipitation environment, limiting potential for acid generation and metal leaching in the short to long-term, and the challenges associated with seepage and run-off control as the stack develops (see Appendix A, Attachment IAAC-104). • Seepage reduction using covers: This option does not reduce seepage during operation but will reduce seepage during closure. The soil cover discussed in the Conceptual Closure Plan (CCP; Appendix 23B of the EIS) will work as a diffusion barrier; the effect of which was modeled and discussed in Volume 4, Appendix K of the EIS. • Seepage reduction using liners: This option will partially be implemented in positions of TMF where high seepage loss is predicted by groundwater model (see response to IAAC-104 below). The complete lining of the TMF was found to be unnecessary based on the effect assessment and has a higher cost than other options. • Collection and recycling seepage: This option allows seepage management at a relatively low-cost during operation and is expected to be effective in combination with the partial liners. i. As per the rationale outlined above, the preferred option for management of ARD/ML for tailings and the TMF is a combination of collection and recycling of seepage, and the selective use of liners where areas of high seepage loss are anticipated. Overall water management around the TMF is discussed in Volume 1, Chapter 2, Section 2.8.2.1 of the EIS and can be summarized as follows: seepage water associated with the TMF will be collected and pumped back to the TMF. Reclaim water from the TMF, underground workings dewatering water, and/or contact water from the water management facility will be used to meet ore milling and processing demand requirements. Tailings and excess water from the ore milling and processing plant (slurry) will be piped to the TMF. Current modelling and engineering feasibility studies show that no discharge from the TMF will be required during normal operation. If discharge is required, it will be monitored and treated to meet relevant federal and provincial regulatory requirements (e.g., the MDMER under the federal *Fisheries Act* and the Manitoba Water Quality Standards, Objectives and Guidelines Regulation under *The Water Protection Act* of Manitoba) prior to discharge to the environment, where applicable. At closure, TMF seepage will be directed to the open pit where partial attenuation of trace elements, cyanide, and ammonia species are expected as described in the Volume 5, Appendix D of the EIS. d. TMF closure is detailed in the CCP (Appendix 23B of the EIS). As discussed in the CCP, the primary usage of stockpiled overburden materials will be to form a 0.5 m thick cover on the TMF and mine rock storage area at the MacLellan site. Similar overburden material has been used in the closure of other mine sites in the Lynn

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	Lake area (e.g., EL Mine site) to provide a media for revegetation (to manage infiltration). As discussed above under part c., the soil cover will work as a diffusion barrier; the effect of which was modeled and discussed in the EIS. Seepage not captured will be collected and managed in a trench system that will direct flow by gravity to the open pit.
Attachment:	Appendix A, Attachment IAAC-102

RESPONSE TO IAAC-103

ID:	**IAAC-103**
Expert Department or Group:	MCCN-22 MCCN-29
Guideline Reference	4.2.2 Community knowledge and Aboriginal traditional knowledge 6.5 Significance of residual effects
EIS Reference	8.1.6 Significance Definition
Information Request:	a. Conduct a revised significance determination for Project effects to groundwater quantity and quality based on the criteria required by the EIS Guidelines, including magnitude, geographic extent, timing, duration, frequency, reversibility, ecological and social context, and environmental standards, guidelines or objectives. i. Describe how Aboriginal traditional knowledge and applicable regulatory documents were considered in the revised significance determination. b. Provide a rationale for groundwater supply wells and their utility for groundwater users as the basis for the significance determination thresholds for effects to groundwater quantity and quality. Incorporate environmental standards, guidelines, or objectives into thresholds. c. Indicate how Indigenous knowledge related to groundwater quantity and impacts to rights, were considered in the development of thresholds for significance determination. i. If this was not completed, indicate how opportunities will be provided to engage with Indigenous Nations regarding the groundwater effects assessment.
Response:	a. As explained in Volume 1, Chapter 4, Section 4.3 of the Environmental Impact Statement (EIS), following the analysis of environmental effects pathways and mitigation measures, the residual environmental effects (i.e., the environmental effects that remain after mitigation has been applied) are described based on the following characterization criteria: direction, magnitude, geographic extent, timing, frequency, duration, reversibility, and ecological/socio-economic context. These criteria are consistent with those identified in Section 6.5 of the Project's Guidelines for the Preparation of an Environmental Impact that were issued for the Project. The Valued Component-specific definitions for each of these criteria with respect to groundwater are presented in Table 8-2 of Chapter 8 of the EIS (Volume 1). Volume 1, Chapter 8, Sections 8.4.2.3 and 8.4.3.3 and 8.4.4 of the EIS characterize the residual environmental effects of the Project on groundwater based on these criteria. Reference is also made to relevant environmental standards, guidelines, or objectives, where available (i.e., the drinking water guidelines noted below), to support characterization of the anticipated residual Project-related change in groundwater quality. Volume 1, Chapter 4, Section 4.3 of the EIS also explains that threshold criteria or standards beyond which a residual environmental effect is considered significant are identified for each environmental effect. The threshold criteria for significant adverse residual effects on groundwater quantity and quality are defined in Volume 1, Chapter 8, Section 8.1.6 of the EIS. The determination of significance for residual effects on groundwater is based on the direct use of groundwater and the ability of current groundwater users to meet their supply needs over the life of the Project. Please see response to part b. for an explanation on the basis of

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	determination of significance for residual Project-related effects on groundwater, which is focused on the end use of groundwater resources by well users, and how other aspects of groundwater were considered as a pathway to other VCs. Further information is provided below in part b. i. No revised significance determination was required. b. The EIS assesses the potential effects of the Project on groundwater quantity and quality with respect to the direct use of groundwater, and also as a pathway to potential effects on surface water quantity and quality. Regarding the former, the determination of significance for residual effects on groundwater quantity is based on the direct use of groundwater and the ability of current groundwater users to meet their supply needs over the life of the Project. Groundwater users typically access groundwater resources through a drilled or dug well; therefore, the threshold employed in the EIS for the determination of significance of predicted Project-related residual environmental effects on groundwater quantity is based on metrics related to a drilled and/or dug well. For groundwater quality, the threshold employed in the EIS for the determination of significance of predicted Project-related residual environmental effects is based on metrics related to drinking water quality, particularly the *Manitoba Water Quality Standards, Objectives, and Guidelines* and the *Guidelines for Canadian Drinking Water Quality*. Regarding the latter, consideration of the potential effects of the Project on groundwater quantity and quality is carried out through the water balance and water quality modelling for the Project, and is incorporated into the assessment of the potential effects of the Project on surface water quantity and quality that is provided in Chapter 9 (Volume 1) of the EIS. The EIS also considers changes in groundwater quantity and quality as a pathway to potential effects on the Vegetation and Wetlands Valued Component (VC) (Chapter 11); the Community Services, Infrastructure, and Wellbeing VC (Chapter 14); the Current Use of Lands and Resources for Traditional Purposes VC (Chapter 17); and the Human Health VC (Chapter 18). As described in the response to MCCN-29, the potential residual adverse environmental effects of the Project on groundwater quantity and quality are characterized in the EIS separately from the ultimate determination of significance for those effects. As explained in Volume 1, Chapter 4, Section 4.3 of the EIS, following the analysis of environmental effects pathways and mitigation measures, the residual environmental effects (i.e., the environmental effects that remain after mitigation has been applied) are described based on the following characterization criteria: direction, magnitude, geographic extent, timing, frequency, duration, reversibility, and ecological/socio-economic context. These criteria are consistent with those identified in Section 6.5 of the EIS Guidelines. The VC-specific definitions for each of these criteria with respect to groundwater are presented in Table 8-2 of Chapter 8 of the EIS (Volume 1). Volume 1, Chapter 8, Sections 8.4.2.3 and 8.4.3.3 and 8.4.4 of the EIS characterize the residual environmental effects of the Project on groundwater based on these criteria. Reference is also made to relevant environmental standards, guidelines, or objectives, where available (i.e., the drinking water guidelines noted below), to support characterization of the anticipated residual Project-related change in groundwater quality.

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As is explained in part a. above, for each environmental effect, threshold criteria or standards beyond which a residual environmental effect is considered significant are identified. The threshold criteria for significant adverse residual effects on groundwater quantity and quality are defined in Volume 1, Chapter 8, Section 8.1.6 of the EIS. The determination of significance for residual effects on groundwater is based on the direct use of groundwater and the ability of current groundwater users to meet their supply needs over the life of the Project. Groundwater users typically access groundwater resources through a drilled or dug well; therefore, the threshold employed in the EIS for the determination of significance of predicted Project-related residual environmental effects on groundwater quantity is based on metrics related to a drilled and/or dug well. For groundwater quality, the threshold employed in the EIS for the determination of significance of predicted Project-related residual environmental effects is based on metrics related to drinking water quality, particularly the *Manitoba Water Quality Standards, Objectives, and Guidelines* and the *Guidelines for Canadian Drinking Water Quality*.

Although the significance determination criteria for the Groundwater VC are focused on the end use of groundwater resources by well users, other aspects of groundwater quantity and quality are also assessed in the EIS. As described in Volume 1, Chapter 8, Section 8.4.1 of the EIS, the environmental effects analysis for groundwater quantity and flow, and groundwater quality, was carried out using a number of analytical methods and tools, including laboratory analytical data, three-dimensional numerical groundwater flow modelling, water quality modelling, and mass balance loading calculations. The Gordon site groundwater flow model was used to provide estimates of:

- Dewatering rates from staged development of the open pit and dewatering of the historical Wendy and East pits and associated changes to groundwater levels (drawdown) and baseflow to surrounding waterbodies.
- Evaluation of mitigation options to control groundwater inflow to the open pit.
- Groundwater inflow rates to the open pit at progressive stages during filling with water to form a pit lake.
- Interactions of the pit lake at the final lake level of 315 m above mean sea level (amsl) with groundwater levels and baseflow to surrounding waterbodies.
- Groundwater recharge originating from overburden storage area, MRSA, and historical MRSAs.

The MacLellan site groundwater flow model was used to provide estimates of:

- Dewatering rates from the staged development of the open pit and dewatering of the historical underground workings and associated changes to groundwater levels (drawdown) and baseflow to surrounding waterbodies.
- Groundwater inflow rates to the open pit at progressive stages during filling with water to form a pit lake.
- Interactions of the pit lake at the final lake level of 330 m amsl with groundwater levels and baseflow to surrounding waterbodies.
- Groundwater recharge originating from the TMF and MRSA.

Water balance and water quality models for each site were used to predict the water quality and recharge associated with the overburden storage areas (at both sites), TMF (at the MacLellan site), MRSAs (at both sites), and historical MRSAs

ID:	**IAAC-103**
	(at the Gordon site) during construction, operation, and decommissioning/closure. The predicted water quality at each site was then used, together with the groundwater discharge rates predicted with the groundwater flow model, to estimate potential effects of Project activities on groundwater quality and loading to surface water receivers. The VC-specific residual effects characterization criteria presented in Table 8-2 (Definitions of Terms Used to Characterize Residual Effects on Groundwater) of Chapter 8 of the EIS (Volume 1) are not exclusively focused on the end use of groundwater resources by well users and include definitions that are more broadly applicable to other aspects of groundwater quantity and quality. For example, the magnitude of a residual effect on groundwater quantity is determined based on the magnitude of the change in groundwater level due to the Project (i.e., no measurable change, change less than 1 m, change between 1 m and 5 m, or change greater than 5 m). However, the magnitude of residual effects on baseflow to waterbodies and watercourses is assessed in the context of the Surface Water VC in Chapter 9 of the EIS. This is because the potential effects of the Project on groundwater are also assessed as a pathway to potential effects on surface water. More specifically, consideration of the potential effects of the Project on groundwater quantity and quality is carried through the water balance and water quality modelling for the Project, and is incorporated into the assessment of the potential effects of the Project on surface water quantity and quality that is provided in Chapter 9 of the EIS. The same assessment methodology that was employed for the Groundwater VC was also applied to the other VCs, including the Surface Water VC. The residual environmental effects of the Project on surface water are described based on characterization criteria that are consistent with those identified in Section 6.5 of the EIS Guidelines. The VC-specific definitions for each of these criteria with respect to surface water are presented in Table 9-5 of Chapter 9 of the EIS. Sections 9.4.1.4 and 9.4.2.4 and 9.4.3 of the EIS characterize the residual environmental effects of the Project on surface water based on these criteria. Reference is also made to relevant environmental standards, guidelines, or objectives, where available (e.g., *Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life* [CWQG-FAL] and the *Manitoba Water Quality Standards, Objectives, and Guidelines for the Protection of Freshwater Aquatic Life* [MWQSOG-FAL]), to support characterization of the anticipated residual Project-related change in surface water quality. The threshold criteria for significant adverse residual effects on surface water quantity and quality are defined in Volume 1, Chapter 9, Section 9.1.6 of the EIS. The determination of significance for residual effects on surface water quantity is based on the magnitude of the change in streamflows or lake levels in the local assessment area (LAA), such that a Project-related change in flow or lake levels amounting to a greater than 30% relative change from existing conditions would be considered a signficant residual adverse effect on surface water quantity. A significant residual adverse effect on surface water quality is defined as a measurable change in water quality parameters that exceed water quality guidelines to an extent that adverse toxicological effects to aquatic life are expected to occur at the community or population level. The magnitudes of residual Project-related changes in groundwater quantity and quality predicted in Chapter 8 of the EIS are therefore factors that directly influenced the determination

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	of significance regarding residual Project-related changes in surface water quantity and quality in Chapter 9 of the EIS. Thus, in additon to the end use of groundwater resources by well users, the assessment of Project effects on groundwater in Chapter 8 of the EIS also considers changes to baseflow to streams and surface water, as well as changes in groundwater quality and associated mass loading to surface water, and these other aspects of groundwater are assessed in Chapter 9 of the EIS with respect to potential residual effects on surface water. The EIS similarly considers changes in groundwater quantity and quality as a pathway to potential effects on the following other VCs: Fish and Fish Habitat (EIS Chapter 10); Vegetation and Wetlands (EIS Chapter 11); Community Services, Infrastructure, and Wellbeing (EIS Chapter 14); Current Use of Lands and Resources for Traditional Purposes (EIS Chapter 17); and Human Health (EIS Chapter 18). c. Volume 1, Chapter 8, Section 8.1.2.1 of the EIS and Volume 2, Chapter 17 of the EIS describe and characterize the engagement with Indigenous Nations including shared Traditional Knowledge (TK) and current land use as it relates to the assessment of effects to the groundwater environment. Indigenous Nations raised concerns regarding the potential for changes in groundwater quality and/or quantity to affect potability, habitat for traditionally used resources, the navigability of watercourses, and the ability and desire of Indigenous peoples to participate in traditional water-based activities (e.g., fishing). Engagement regarding the Project commenced in 2017, was ongoing through the EIS, and will continue through the life of the Project. Engagement is detailed in Chapter 3 of the EIS. While concerns were generally raised as noted above, there were no key issues raised by Mathias Colomb Cree Nation with respect to groundwater. No other key issues were raised by Indigenous Nation with respect to groundwater. Alamos will engage with Indigenous Nations regarding the design and implementation of Project follow-up and monitoring programs, including evaluation of program results, and subsequent updates to the program. Alamos will discuss planned monitoring activities with directly-affected Indigenous Nations and provide opportunities for Indigenous Nations to participate in these follow-up and monitoring programs. Information on conceptual monitoring and management plans was provided to Indigenous Nations on April 21 (registered mail) and April 22 (email), 2021. Alamos has not received any comments from Indigenous Nations regarding this material to date. In addition, a direct response to these comments from Mathias Colomb Cree Nation (MCCN-22 and MCCN-29) were provided to the Nation on February 22, 2021, incorporating the information in the response above and seeking additional comment. No response has been received to date. i. Response provided above under c.
Attachment:	No

RESPONSE TO IAAC-104

ID:	**IAAC-104**
Expert Department or Group:	MMF-08 MMF-10
Guideline Reference	2.2 Alternative means of carrying out the project 2.4 Application of the precautionary approach 6.1.5 Groundwater and Surface Water 6.6.1 Effects of potential accidents or malfunctions 8.0 Follow-up and Monitoring Programs
EIS Reference	8.9 Follow-up and Monitoring 9.9 Follow-up and Monitoring 22.5.1 Tailings Management Facility Malfunction 22.5.2.3 Environmental Effects Assessment Volume 4, Appendix F Geochemistry Baseline Technical Data Report Appendix B Tables 4.3-1 and 4.3-5
Information Request:	a. Describe the potential for lining the TMF and MRSAs with an impermeable foundation, such as a geomembrane, to minimize the interaction between surface water and groundwater. b. Describe and assess the changes to the effects assessment if a liner is used. c. Provide an alternative means assessment and rationale demonstrating the preferred type of tailings (i.e., slurry, paste, dry stack). d. Indicate whether an independent tailings review board will be established prior to TMF construction, given the geochemical risks of the TMF. i. If an independent tailings review board is established, indicate how this board could assist in mitigating and managing risks associated with the TMF. e. Indicate if current Project plans allow the expansion of the TMF capacity using the downstream raise dam design should the life of mine be extended beyond the expected mine life and describe the potential implications of any expansions of the TMF. i. If the proponent is unable to expand the TMF capacity at the proposed location, indicate where additional tailings generated by the Project could be stored. f. Indicate how Indigenous knowledge was incorporated into the design of the TMF.
Response:	a. The proposed design for the tailings management facility (TMF) involves the construction of a High Density Polyethylene (HDPE) liner on the upstream slopes of the dams tied into the bedrock foundation via a concrete plinth. Additional investigations during the detailed engineering phase of the Project will identify which portions of the dam alignment may require grouting of the bedrock foundation and the depth of grouting required to reduce hydraulic conductivity of the foundation and reduce the risk of excess seepage downstream. A seepage collection system will be located downstream of the dams along the north, west, and a portion of the east end of the TMF, that will direct foundation seepage to a series of sumps that will then pump the water back into the TMF. This approach, in combination with grouting of the bedrock foundation, where required, is preferred, compared with lining the entire footprint of the TMF, because it will allow the tailings to consolidate and gain strength over time to facilitate closure and improve long-term stability, and is also more economically feasible.

ID:	**IAAC-104**
	b. Geochemical testing indicates that mine rock generated at the MacLellan and Gordon sites contains potentially acid generating (PAG) materials and shows a leaching potential for arsenic and other trace elements as discussed in detail in Volume 1, Chapter 5, Section 5.2.6 of the Environmental Impact Statement (EIS). Blending of PAG and non-PAG material and/or dry and/or wet covers will be used to control ARD/ML from mine rock and is the preferred method of control compared with lining of the mine rock storage area (MRSA) (see response to IAAC-99). The liner described in a. above was included in the modelling conducted as part of the assessment, therefore there is no change to the conclusions of the environmental assessment presented in the EIS. Information on how this liner was included in groundwater modelling is provided in the response to IAAC-87 (Figure IAAC-87-1). c. The EIS identified and considered the environmental effects of technically and economically feasible alternative means of carrying out the Project in accordance with the Operational Policy Statement under the Canadian Environmental Assessment Act, 2012. In addition to conventional disposal, both filtered tailings and co-disposal were considered as alternative tailings disposal methods. Alternatives were assessed at a trade-off study level. Refer to Table IAAC-104-1 attached to this response. Volume 1, Chapter 2, Section 2.9.3.3 of the EIS also considers potential alternative locations for key Project infrastructure, including the TMF. d. During detailed engineering, Alamos will consider retaining an independent TMF review board to review the detailed design of the TMF. This review could also be completed by a senior independent technical reviewer in line with the Global Industry Standards on Tailings Management. The goal of the review would be to confirm that plans and design criteria for the tailings facility reduces risks for all phases of the life cycle, including closure and post-closure. i. The reviewer could assist in mitigating and managing risks associated with the TMF through review of detailed TMF design to identify risks and provide guidance on industry standards, as required. e. (including i.) The capacity of the proposed ultimate configuration of the TMF is sufficient to accommodate the current Project design. Expansion of the TMF beyond the current proposed ultimate configuration, and the extension of the mine life is not currently planned. f. Volume 1, Chapter 2, Section 2.9.1 of the EIS indicates how Indigenous traditional knowledge was incorporated into the design of the TMF. Traditional knowledge was shared by Indigenous Nations through the engagement program, as described in Chapter 3 of the EIS, and Project-specific traditional land and resource use (TLRU) studies, as described in Chapter 17 of the EIS. Project design and siting took into consideration traditional practices, sites, and areas, including hunting, trapping, fishing, plant gathering and the resources on which these depend, use of trails and travelways, use of habitation areas, and use of cultural and spiritual sites and areas. No new information from Indigenous Nations has been received related to the design of the TMF since the submission of the EIS and additional supplemental filing on engagement provided in March 2021. No changes to the design of the TMF are therefore proposed. A direct response to comments from Manitoba Metis Federation (MMF-08 and MMF-10) was provided to Manitoba Metis Federation on

ID:	**IAACC-104**
	February 5, 2021, incorporating the information in the response above, and seeking additional comment. No response has been received to date. Alamos' engagement with Indigenous Nations will be ongoing for the life of the Project.
Attachment:	Appendix A, Attachment IAAC-104.

RESPONSE TO IAAC-105

ID:	**IAAC-105**
Expert Department or Group:	NRCan-46
Guideline Reference	2.2 Alternative means of carrying out the project
EIS Reference	2.9 Alternative Means for Carrying Out the Project Table 20A-1 Volume 5, Appendix D Lynn Lake Gold Project, Hydrology Water Balance and Water Quality Impact Assessment: Gordon site Technical Modelling Report Appendix I The Minerals and Metals Policy of the Government of Canada; Natural Resources Canada (1996)
Information Request:	a. Conduct and provide an alternative means assessment for mine waste management at the Gordon site, including a comparison of backfill of waste rock in the open pit with the placement of an engineered cover on the MRSA at closure. i. Describe the methodology used to conduct the alternative means assessment, including what guidelines and policies were followed to conduct the alternative means assessment. ii. Identify the preferred option for mine waste disposal and the associated rationale.
Response:	a. The preferred option for mine rock disposal at the Gordon site is the use of a soil cover placed over the proposed mine rock storage area (MRSA) as described in the Project Conceptual Closure Plan provided in Appendix 23B of the Environmental Impact Statement (EIS). This cover will be the primary use for overburden stockpiled at both sites during construction and operation. The disposal of mine rock in the open pit is not considered economically feasible due to the high costs of recovering (double handling) the mine waste and transporting the relatively high haul distance from the far end of the MRSA to the open pit. This distance is upwards of 1.5 km at the Gordon site. This additional transportation would also result in the generation of additional greenhouse gases (GHG), resulting in adverse effects to air quality. See Table IAAC-105-1 attached to this response for further detail on the alternative means assessment. i. The assessment of alternative means was completed in accordance with the Canadian Environmental Assessment Agency's Operational Policy Statement "Addressing 'Purpose of' and 'Alternative Means' under the Canadian Environmental Assessment Act, 2012". The alternative means assessment included the following methods: • Describing each identified alternative to the extent needed to identify and compare potential environmental effects. • Considering the environmental (including socio-economic) effects of the identified technically and economically feasible alternative means of carrying out the Project. • Selecting the preferred alternative means of carrying out the Project, based on the relative consideration of effects.

ID:	**IAAC-105**
	ii. See response to a. above.
Attachment:	Appendix A, Attachment IAAC-105

RESPONSE TO IAAC-106

ID:	**IAAC-106**
Expert Department or Group:	NRCan-50
Guideline Reference	2.2 Alternative means of carrying out the project
EIS Reference	5.2.6 Geochemistry 8.4 Assessment of Residual Environmental Effects on Groundwater 10.0 Assessment of Potential Effects on Fish and Fish Habitat 20.1 Summary of Changes to the Environment, Potential Effects, Mitigation and Residual Effects
Information Request:	a. Conduct and provide an alternative means assessment for mine waste management at the MacLellan site, including a comparison of backfill of waste rock and/or tailings in the open pit with the placement of an engineered cover on the WRSA and TMF at the final closure stage of the Project for the MacLellan site. i. Assess the potential residual effects on water quality parameters with CCME water quality guidelines for the protection of aquatic life, including nickel and selenium. ii. Describe the methodology used to conduct the alternative means assessment, including what guidelines and policies were followed to conduct the alternative means assessment. iii. Identify the preferred option for mine waste disposal and the associated rationale.
Response:	a. The preferred option for mine rock and tailings disposal at the MacLellan site is the use of a soil cover placed over the proposed mine rock storage area (MRSA) and tailings management facility (TMF) as described in the Project Conceptual Closure Plan provided in Appendix 23B of the Environmental Impact Statement (EIS). This cover will be the primary use for overburden stockpiled at both sites during construction and operation. The disposal of mine rock and tailings in the open pit is not considered economically feasible due to the high costs of recovering (double handling) the mine waste and transporting the relatively high haul distance from the far end of the MRSA to the open pit. This distance is upwards of 4.5 km at the MacLellan site. This additional transportation would also result in the generation of additional greenhouse gases (GHG), resulting in adverse effects to air quality. See Table IAAC-106-1 below for further detail on the alternative means assessment. i. As no feasible alternatives were identified, the conclusions of the EIS related to water quality parameters are unchanged. ii. The assessment of alternative means was completed in accordance with the Canadian Environmental Assessment Agency's Operational Policy Statement "Addressing 'Purpose of' and 'Alternative Means' under the Canadian Environmental Assessment Act, 2012". The alternative means assessment included the following methods: • Describing each identified alternative to the extent needed to identify and compare potential environmental effects.

ID:	**IAAC-106**
	- Considering the environmental (including socio-economic) effects of the identified technically and economically feasible alternative means of carrying out the Project. - Selecting the preferred alternative means of carrying out the Project, based on the relative consideration of effects. iii. See response to a. above.
Attachment:	Appendix A, Attachment IAAC-106

RESPONSE TO IAAC-107

ID:	**IAAC-107**
Expert Department or Group:	ECCC-11
Guideline Reference	6.2.2 Changes to groundwater and surface water 6.3 Predicted effects on valued components 6.3.1 Fish and fish habitat
EIS Reference	Volume 5, Appendix F Lake Gold Project, Hydrogeology Assessment – Gordon site Technical Modelling Report Tables 5-2, 5-4, 5-7 and 5-9 Appendix G Lynn Lake Gold Project, Hydrogeology Assessment - MacLellan site Technical Modelling Report Tables 5-4, 5-8, 5-9, 5-12 and 5-13
Information Request:	a. Clarify and provide the following information for the groundwater travel time prediction tables presented in the hydrogeology assessments for the Gordon site (i.e., Tables 5-2, 5-4, 5-7 and 5-9; EIS Volume 5, Appendix F) and the MacLellan site (i.e., Tables 5-4, 5-8, 5-9, 5-12 and 5-13; EIS Volume 5, Appendix G): i. what potential scenarios would favour the minimum groundwater travel times over the mean and maximum travel times; ii. which groundwater travel time metric(s) (i.e., minimum, mean, or maximum) were used to identify surface and groundwater exceedances; and iii. the hydrostatic units through which the particles travel from source to surface water receptor. b. Describe whether and how the minimum groundwater travel times informed the effects assessment, mitigation measures, management, and monitoring, with respect to surface and groundwater quality, and fish and fish habitat.
Response:	a. In relation to the groundwater travel time prediction tables: i. The travel times of seepage from the mine feature to the receiver were estimated using particle tracking techniques. Depending on the size of the mine feature, dozens to hundreds of particles were placed at the water table within the footprint of the mine feature and allowed to flow to the ultimate receiver for the given model scenario (construction, operation, and closure). The travel time statistics presented in the MacLellan and Gordon Hydrogeology Assessment Technical Modelling Reports (Volume 5, Appendices F and G, respectively, of the Environmental Impact Statement [EIS]) are based on the minimum, mean, and maximum advective travel time of the particles that were released from the given mine component for the given model scenario. Therefore, the travel time statistics are reflective of the various flow paths from the source to the receptor. The minimum travel times reflect the shortest flow path from the mine component to the receptor, primarily corresponding to portions of the mine component located closest to the receptor. The maximum travel times reflect the longest flow path from the mine component to the receptor, primarily particles that are released within the portion of the mine component located farthest from the receptor or particles that travel deeper into the aquifer relative to other particles prior to reaching the receiver.

ID:	**IAAC-107**
	ii. It is not clear what groundwater exceedances the reviewer is referring to. Alamos has interpreted the information request to correspond with groundwater quality exceedances. The assessment of effects of the Project on groundwater quality was conservative because reductions in groundwater discharge to the natural environment did not consider the attenuation of groundwater quality along the groundwater flow path from the source to the receptor. Further, the assessment of groundwater quality was conservative in that we assumed all seepage from the mine component would reach the receiver within the modelled scenario. For example, at the MacLellan site the operation phase of mine life is 13 years and it was assumed the groundwater seepage from the mine rock storage area (MRSA) and tailings management facility (TMF) would reach the receiver within this time frame whereas the groundwater flow model predicts much longer travel times (mean travel times of 81 to greater than 1,000 years). The very long travel times from the mine components to the receivers suggest that natural attenuation may limit the extent of elevated concentrations of parameters in groundwater from the mine components and the full effect of seepage from the mine component to the receiver may never be realized. Therefore, the assessment of effects of the Project on groundwater quality was conservative. iii. The attached tables (Appendix A, Attachment IAAC-107) highlight the hydrostratigraphic units the particles in the respective groundwater flow models travelled through from source to receiver for the Project facilities at the Gordon and MacLellan sites. b. Please refer to response to a.ii. As stated, the assessment of effects of the Project on groundwater and subsequently surface water was conservative in that it was assumed that the seepage from the mine component would discharge to the receiver within the time frame of the model scenario whereas the predicted travel times are substantially longer (i.e., we assumed a travel time that was less than the minimum predicted travel time). Follow up monitoring will be completed to confirm the assessment of effects of the Project (see Volume 3, Chapter 23 of the EIS). With respect to groundwater, follow up monitoring will include groundwater quantity (level, pumped volumes) and quality (general chemistry and select dissolved metals) monitoring with an adaptive management component. The adaptive management component will include triggers and thresholds for groundwater quantity and quality that alert to changing conditions and allow flexibility to address/accommodate new circumstances, adjust monitoring, implement new mitigation measures, and/or modify existing measures, if required. Further details on the monitoring are presented in the response to IAAC-73. The travel times predicted using the groundwater model will be used to inform the follow up and monitoring program so that the groundwater monitoring well network associated with the MRSAs and TMF can be designed to allow early detection of seepage from mine components to confirm predictions of the EIS.
Attachment:	Appendix A, Attachment IAAC-107

RESPONSE TO IAAC-108

ID:	**IAAC-108**
Expert Department or Group:	IAAC
Guideline Reference	6.1.5 Groundwater and Surface Water 8.0 Follow-up and Monitoring Programs
EIS Reference	8.4.3 Assessment of Change in Groundwater Quality 8.9 Follow-up and Monitoring 9.9 Follow-up and Monitoring 22.5.2.3 Environmental Effects Assessment 23.5.4 Groundwater Monitoring Plan 23.5.5 Surface Water Monitoring and Management Plan
Information Request:	a. Provide predictions of groundwater quality near the TMF and WRSAs during all phases of the Project. b. Provide predictions of groundwater travel time from the MRSAs and TMF to potential down gradient monitoring locations. c. Describe the flow paths from the TMF and MRSA facilities to the receiving surface water including the depth of flow and various hydrostratigraphic units. i. Include the proportion of the seepage that is transmitted through overburden units versus bedrock units, and any differences in travels times. d. Provide preliminary monitoring plans for the TMF and MRSAs, including groundwater and surface water monitoring. i. Identify how monitoring will be used to validate predictions and inform model updates. ii. Describe how adaptive management will occur in response to monitoring.
Response:	a. In the Environmental Impact Statement (EIS), we have evaluated the effects of groundwater discharge originating from the tailings management facility (TMF) and mine rock storage areas (MRSAs) on surface water quality using a conservative approach with no attenuation within the subsurface due to physical and chemical flow processes (i.e., water from directly beneath Project infrastructure is the same as that which discharges to the environment). Seepage quality from the TMF and MRSAs to groundwater is presented in Volume 1, Chapter 8, Appendix A of the EIS) particularly Table 8A-8 for the Gordon site and Table 8A-9 for the MacLellan site for construction, operation, and closure phases of the Project. Alamos anticipates groundwater quality at downgradient monitoring wells to be better quality than presented in Table 8A-8 and Table 8A-9 due to physical or chemical processes that will result in attenuation. b. Please refer to response to comment IAAC-107. As stated in response to comment IAAC-107, the groundwater flow travel times from the MRSAs and TMF to the receiving environment are long. Further, the groundwater flow model particle tracking predicts that the seepage will not have migrated far beyond the footprints of the MRSA and the TMF by end of operations. The groundwater flow model will be used to aid in delineating the groundwater monitoring network to locate downgradient monitoring wells at sufficient distance from the MRSAs and TMF to confirm groundwater seepage quality from the source, as well as at a distance from the source to confirm attenuation in the groundwater flow system and

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concentrations prior to discharge to surface water features. The monitoring wells will be placed where effects to groundwater (quantity/quality) will be realized during Project operation. In particular for groundwater quality, monitoring wells will be located where seepage from the MRSAs and/or TMF may be confirmed in the initial stages of the Project (e.g., closer to or underneath the source). With additional monitoring wells placed further downgradient to confirm potential attenuation of that seepage along the groundwater flow path, the prediction of effects of the Project may be confirmed prior to the end of closure. In this regard, follow up monitoring and mitigation measures proposed for closure may then be confirmed and/or optimized.

c. Please refer to IAAC-107; the various hydrostratigraphic units along the flow path from the Project facilities to the receiving environment are listed in Table IAAC-107. At the Gordon site, particles released from the new MRSA were predicted to extend up to 32 m in depth prior to reaching a surface water receiver. At the MacLellan site, particles released from the new MRSA and TMF were predicted to extend up to 40 m and 28 m depth, respectively, prior to reaching a surface water receiver.

    i. In closure, at the Gordon site, 95% of the particles released from the MRSA are predicted to encounter bedrock (greater than 10 m depth below ground surface) along the flow path prior to discharge to a surface water receiver.

    At the Gordon site, in closure, seepage from the MRSA is predicted to discharge to the Pit Lake (40%), Susan Lake (32%), Farley Lake (20%), and Gordon Lake (7%). Of the particles released from the MRSA, 95% are predicted to encounter bedrock (greater than 10 m depth below ground surface) along the flow path prior to discharge to a surface water receiver.

    At the MacLellan site, in closure, the majority of seepage from the MRSA is predicted to discharge to the Pit Lake (16%), Minton Lake (58%), and a tributary of the Keewatin River (25%). Of the particles released from the MRSA, only 3% are predicted to encounter bedrock (greater than 10 m depth below ground surface) along the flow path prior to discharge to a surface water receiver.

    The majority of seepage from the TMF is predicted to discharge to a tributary of the Keewatin River (66%), Minton Lake (23%), the Keewatin River (4%) and the Pit Lake (4%). Of the particles released from the TMF, 60% are predicted to encounter bedrock (greater than 10 m depth below ground surface) along the flow path prior to discharge to a surface water receiver.

    The minimum and mean travel times of particles released from the Project facility to the receiving environment were presented in Volume 1, Chapter 8, Tables 8A-09 and 8A-10 of the EIS.

    In general, with deeper predicted flow and flow extending into bedrock, the travel time of a given particle from source to receptor is predicted to increase relative to shallower flow and flow through overburden.

d. Initial details for the preliminary conceptual groundwater and surface water monitoring programs were presented in Volume 1, Chapter 8, Section 8.9 and Volume 1, Chapter 9, Section 9.9, respectively, of the EIS. Finalization of the plans will occur during the permitting stage of the Project (i.e., following receipt of a federal Decision Statement for the Project under *CEAA 2012* and provincial

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	licences for the Project under *The Environment Act* of Manitoba) and will be completed prior to the start of Project construction. The monitoring plans for the TMF and MRSAs will include a groundwater and surface water component. The response to IAAC-73 provides additional details on the Groundwater Management and Monitoring Plan (GMMP). The groundwater component will include the installation of monitoring wells located downgradient, upgradient, and cross gradient of the TMF and MRSAs including monitoring immediately adjacent to the TMF and MRSAs and at a distance downgradient of these locations to confirm attenuation in the groundwater flow system and concentrations prior to discharge to surface water features. This will provide for development of trigger thresholds if water quality is different from model predictions so that investigation and, if applicable, adaptive management and/or mitigation may be implemented, as applicable. The surface water monitoring component will include monitoring of water quantity (stream flows, lake levels) and water quality downstream of the TMF at the MacLellan site and the MRSAs at the MacLellan and Gordon sites. The objectives of the Surface Water Management and Monitoring Plan (SWMMP) will be to: • Establish and/or maintain reference monitoring sites to differentiate between natural seasonal or climatic variability in surface water quantity and quality and potential Project effects as the Project progresses. • Monitor potential changes in lake level and stream flows downstream of the TMF and MRSAs, to validate water balance model predictions and assess the effectiveness of mitigation measures, in response to construction, operation, and closure of the Gordon and MacLellan sites. • Monitor potential change in water quality in lakes and stream downstream of the TMF and MRSAs, to validate water quality model predictions and assess the effectiveness of mitigation measures, in response to construction, operation, and closure of the Gordon and MacLellan sites. • Maintain a surface water quantity and surface water quality monitoring network sufficient to evaluate if quantitative thresholds are exceeded and to assess effectiveness of subsequent adaptive management measures. Monitoring potential changes in surface water quantity will follow guidelines recommended for collection of surface water quantity data (e.g., BC MOE 2018, Terzi 1981, ISO 2010). Monitoring potential changes in surface water quality will follow guidelines recommended in collection of surface water quality data (e.g., BC MoE 2016; Environment Canada 2012). Data from reference sites will be compared with data from sites downstream of the Project to determine if observed changes are due to larger phenomena occurring in the region or are due to Project-related effects. These data will allow for the “before-after-impact-control” study design. Monitoring sites for surface water quantity and surface water quality will be the same (to enable loading calculations) and will include near-field, far-field, and reference sites. Monitoring sites at the Gordon site are expected to include stations adjacent to the MRSA and open pits (i.e., Gordon Lake, Diversion Channel, and Farley Lake [west and east basins]), within the zone of potential groundwater influence (i.e., Susan Lake, Marie Lake, Marnie Lake), and downstream of contact water effluent discharge (i.e., Farley Creek; Swede Lake, Ellystan Lake). Reference sites at the Gordon site will include Simpson Lake and White Owl Lake.

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	Monitoring sites at the MacLellan site are expected to include stations adjacent to the TMF and MRSA (i.e., Payne Lake, Minton Lake), adjacent to the open pit (i.e., East Pond), downstream of contact water effluent discharge (i.e., Keewatin River), downstream of TMF/MRSA seepage (i.e., Minton Lake, outlet of unnamed lake downstream of Minton Lake, Cockeram River), downstream of open pit over-flow at closure (i.e., Keewatin River tributary KEE3-B1), and downstream of the Project (i.e., Cockeram Lake). Three stations will be monitored in the Keewatin River: one upstream of the Project (reference site), one immediately downstream of the proposed effluent discharge location (i.e., at the MacLellan Bridge), and one downstream of the Lynn River confluence. A station will also be established in the Lynn River, a source of non-Project related past and ongoing contamination to the Keewatin River. In addition to the site upstream of the Project in the Keewatin River, two other reference sites will be monitored: Burge Lake and Arbor Lake. The final number and location of surface water monitoring locations will be determined after the mine design has been finalized and in collaboration with ECCC, MCC, and local Indigenous Nations. Water levels and stream discharges will be monitored at each site by installing and maintaining datalogging pressure transducers. Pressure transducers will be installed at all sites prior to construction and will be maintained until the end of closure when the open pits at the Gordon and MacLellan sites are filled with water. Data from the pressure transducers in lakes will be converted to metres above sea level (masl) by concurrently measuring water surface elevation in the lake and elevations at permanent benchmarks installed at each site. Each benchmark will be georeferenced in space and height with Real Time Kinematic (RTK) survey equipment. Data from the pressure transducers in streams will be converted to stream discharge using ratings curves developed from concurrent discharge and water level measurements. Benchmarks will be established at each site to convert relative water level data from the transducers to absolute water levels for the stage-discharge relationships. Discharge measurements in wadable streams will be recorded with a hand-held velocity meter. Discharge measurements in non-wadable rivers will be recorded with an Acoustic Doppler Current Profiler. The frequency of stream discharge measurements in each stream will vary seasonally and will be dependent on the stability of the rating curve, the goodness of fit of the stage-discharge relationship, and the hydraulic conditions in each creek. Stream discharge will be measured during winter to calibrate estimates for the low flow period. During the winter, ice encroachment in the channels negates the applicability of the stage-discharge relationship developed during the open water season. Water quality sampling from streams and rivers will be conducted by collecting water from the stream bank with an extension pole, from a bridge, or by wading. Water quality samples from lakes will be conducted from a boat from stations in the deepest basin. Prior to sample collection, a vertical temperature, conductivity, and dissolved oxygen profile will be conducted in the lake to determine the depth of the thermocline (if present). During the summer months when the lakes are stratified, separate samples from the epilimnion (i.e., surface) and hypolimnion (i.e., bottom) are expected to be collected. In spring, fall, and winter when the lakes are mixed, composite samples comprised of water from surface and bottom

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	are expected to be collected. For each method, water will be collected in sterile, plastic bottles. *In-situ* water quality parameters (i.e., temperature, pH, specific conductivity, turbidity, dissolved oxygen concentration, redox potential) will be measured at each site with a calibrated multi-meter. Samples will be sent to Canadian Association of Laboratory Accreditation (CALA) certified laboratory in Winnipeg, Manitoba. In the lab, water samples will be analyzed for total and dissolved metal concentrations (e.g., copper), metalloids (e.g., selenium), major anions (e.g., sulphate), nutrients (e.g., nitrate), organics (e.g., total and dissolved carbon), and physical parameters (e.g., pH, total dissolved solids). Samples at the MacLellan site will also be tested for cyanide species. Samples will be collected at an appropriate regular frequency from each site over the life of the Project. Samples will be collected during the spring freshet each year to characterize water quality during the period of highest watershed run-off. Sampling will continue into the post-closure phase until water quality downstream of the Gordon and MacLellan sites has stabilized and meets applicable Manitoba or Canadian water quality guidelines or site-specific water quality objectives as determined during the permitting phase in consultation with ECCC, MCC, and local Indigenous Nations. Results of the groundwater and surface water monitoring will be summarized in annual reports that will be provided, by the end of each year, to the Impact Assessment Agency of Canada, ECCC, DFO, local Indigenous Nations and/or the Environmental Committee established for the Project. Results of the water quality monitoring program will be presented to show long-term trends, statistical differences (if any) between exposure and reference sites, and comparison to applicable Manitoba and/or Canadian water quality guidelines and/or site-specific water quality objectives. i. Monitoring results from the groundwater quantity, surface water quantity, groundwater quality, and surface water quality monitoring programs will be used to validate predictions and inform model updates by providing yearly data, which will be added to growing databases for groundwater, hydrology, and water quality, that will then be used to conduct qualititative, graphical, and quantitative (i.e., statistical) analysis comparing data collected during construction, operations, closure/decommissioning, and post-closure phases to groundwater, water balance, and water quality model predictions. Increasing larger datasets will provide increasingly greater statistical power and precision to compare field data and model predictions over time. Statistically significant differences between model predictions and field data will be used to signal when model updates are required. These updates, when necessary, will be driven by sensitivity analyses which will identify which model inputs, constants, or assumptions have the greatest influence on the models and, therefore, should be changed for improving model predictions. ii. Adaptive management will be used with respect to groundwater and surface water to identify, assess the environmental significance of, and as appropriate, respond to, an effect of the Project on groundwater and/or surface water

beyond that predicted in the EIS. Important aspects of the adaptive management framework for groundwater and surface water are as follows:

- Risk narrative: description of the component and potential environmental impacts and/or conditions that implementation of the adaptive management plan will limit.
- Monitoring component: monitoring location and physical parameters to be monitored and assessed.
- Trigger: a specific threshold that initiates action when exceeded. Trigger thresholds are staged to accommodate levels of concern and a diversity of actions. Allows timely and informative responses to be initiated before higher potential impact trigger thresholds are met or exceeded. Trend analysis is an early warning tool to determine potential for exceeding subsequent thresholds. Thresholds for groundwater will include groundwater level and quality. Thresholds for surface water will include lake level elevation and stream discharge as well as water quality thresholds for Parameters of Concern.
- Response Actions: staged according to specific thresholds and describes the actions to be implemented should a threshold be crossed. The response actions will include a hierarchical plan to investigate the potential causes of threshold exceedance to determine if the threshold exceedance is related to measurement error, equipment malfunction, a single anomalous event, a naturally occurring local phenomenon, a regional phenomenon, or a Project-related effect. A hierarchical plan will be used to implement remedial actions to existing mitigation measures or to implement additional or new mitigation measures to reduce or eliminate threshold exceedances. Mitigation measures may include additional monitoring, or modifications to Project infrastructure.
- Reporting and Review: A plan to report Project-related threshold exceedances to the appropriate regulatory authorities.

This adaptive management framework allows for a systematic approach to data evaluation and the identification of actions that are commensurate with the degree of risk potentially associated with the occurrence of data that is different than baseline. Data that are elevated above triggers and indicate a higher degree of risk to the environment would have more substantial response actions compared to minor changes in data that would be appropriately followed, monitored, and acted upon as necessary.

References:

British Columbia Ministry of Environment (BC MoE). 2016. Water and Air Quality Baseline Monitoring Guidance Document for Mine Proponents and Operators. Version 2.0 June 2016.

British Columbia Ministry of Environment (BC MoE). 2018. Manual of British Columbia Hydrometric Standards. Version 2.0. Prepared for the Resources Information Standards Committee.

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	Environment Canada. 2012. Metal Mine Technical Guidance for Environmental Effects Monitoring. Ottawa, Ontario. Manitoba International Standards Organization (ISO). 2010. ISO 1100-2: 2010. Hydrometry – Measurement of liquid flow in open channels – Part 2: Determination of the stage discharge relationship. 3rd ed. ISO, Switzerland. Terzi, R.A. 1981. Hydrometric field manual – measurement of streamflow. Environment Canada, Inland Waters Directorate, Ottawa, ON.
Attachment:	No

RESPONSE TO IAAC-109

ID:	**IAAC-109**
Expert Department or Group:	MCCN-20
Guideline Reference	4.3 Study strategy and methodology
EIS Reference	8.2.1.1 Baseline Hydrogeological Study
Information Request:	a. Provide a rationale for the selection of monitoring locations, including an evidence-based rationale for the deficiency of monitoring locations within the respective LAAs and RAAs relative to the concentration of monitoring locations within the PDAs.
Response:	a. The groundwater monitoring network for the Project was established to understand environmental as well as geotechnical conditions. Drilling and monitoring well installations completed as part of the geotechnical drilling program to support engineering design were incorporated into the environmental baseline understanding of groundwater. Therefore, additional monitoring wells are concentrated in the Project Development Area (PDA) as a reflection of the detailed geotechnical program to support mine design that occurs concurrently to the environmental baseline monitoring. The groundwater monitoring well network to establish baseline groundwater conditions was developed based on background review and a preliminary assessment of potential effects of the Project. The preliminary mine plan was reviewed and baseline monitoring wells were placed in areas of mine features to understand groundwater flow pathways and baseline groundwater quality. Additional monitoring wells were placed in areas upgradient of mine features to establish long-term background groundwater level and quality monitoring locations for the Project. The potential influence of open pit dewatering on groundwater elevation was coarsely estimated based on analytical solutions and the open pit design that was available at the time. Monitoring wells were placed within and around this potential radius of influence of open pit dewatering to understand baseline conditions for groundwater. As presented in Volume 1, Chapter 8 of the Environmental Impact Statement, groundwater flow, and thus seepage pathways, are controlled by topography with groundwater discharge to nearby surface water features limiting the length of flow pathways. In addition, drawdown resulting from open pit dewatering is limited. The monitoring well network that has been established for the Project adequately characterizes baseline conditions when considering the assessment of potential effects of the Project on groundwater.
Attachment:	No

RESPONSE TO IAAC-110

ID:	**IAAC-110**
Expert Department or Group:	NRCan-48
Guideline Reference	6.4 Mitigation measures
EIS Reference	5.2.6 Geochemistry 8.4 Assessment of Residual Environmental Effects on Groundwater 20.1 Summary of Changes to the Environment, Potential Effects, Mitigation and Residual Effects Table 20A-1
Information Request:	a. Provide surface water and sediment quality modelling downstream of the Gordon and MacLellan sites using more conservative water quality estimates in the collection ponds (i.e., assuming that MDMER limits are reached in the collection pond). Modelling should extend downstream until effects are no longer measurable. b. Using results of surface water and sediment modelling conducted in part a, identify associated ecological risks in the event that MDMER limits in the collection ponds are reached. i. If additional risks are identified, identify mitigation measures and describe the criteria and parameters that would trigger treatment measures. Identify follow-up and monitoring plans, and indicate how effects would be adaptively managed.
Response:	a. Alamos is of the opinion that the existing water quality model scenarios provide a robust and conservative effects assessment. This is because the model scenarios included an Expected Case and a conservative Upper Case modelling scenario to predict contact water quality (including collection pond water quality) and to predict potential changes in surface water quality in the downstream receiving environment. Volume 3, Chapter 22, Section 22.4.2 and 22.5.2.3 of the Environmental Impact Statement (EIS) describes the potential affects of an accident or malfunction resulting in the release of untreated contact water. Estimates of a worst-case release will be undertaken as part of detailed engineering design and contingency planning. As described in Volume 1, Chapter 9, Section 9 of the EIS, the Upper Case is a conservative modelling scenario that is unlikely to occur in any phase of the Project. For both the Expected and the Upper Case scenarios, contact water quality (including collection pond water quality) was predicted to remain below MDMER limits and short-term water quality guidelines. One exception in the Upper Case scenario was an exceedance of the Manitoba short-term guideline and the MDMER Schedule 4 limit for ammonia at the MacLellan site collection pond during operation (EIS Chapter 9, Appendix 9E). However, predicted ammonia concentrations for the Upper Case scenario do not exceed the long-term ammonia guideline in the receiving environment, including the Keewatin River, the nearest model node downstream of collection pond discharge. b. Because the Upper Case model results already represent a conservative and unlikely scenario, Alamos is of the opinion that it is even less likely that parameter concentrations in the collection ponds will reach concentrations at the MDMER

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	Schedule 4 effluent limits. This is because these limits are not exceeded even when the most conservative modelling assumptions are incorporated into the water quality model. Therefore, Alamos is of the opinion that undergoing additional modelling that assumes the MDMER limits will be achieved in mine contact water does not provide a reasonable scenario with which to assess potential changes in surface water quality in the receiving environment. The surface water quality models extended far enough downstream, to nodes where effects are no longer measurable. At the Gordon site, the farthest downstream model assessment node was at Ellystan Lake (node 'Ellytsan'; site 'AQF20') at the southern edge of the Gordon site local assessment area (LAA). No residual effects were predicted at this node. The farthest downstream node where residual effects were predicted was Swede Lake (node 'Swede'; site AQF15). At the MacLellan site, the farthest downstream model assessment node was in southern Cockeram Lake (node QM08; site AQM11) at the southern edge of the MacLellan site LAA. No residual effects were predicted at this node. The farthest downstream node where residual effects were predicted was node QM06 (site AQM8) in the Keewatin River, before the confluence with Lynn River. As described in the response to IAAC-41 and Volume 1, Chapter 9, Section 9.5.1 of the EIS, predictions for Project-related changes in surface water quality implicitly capture potential cumulative effects associated with past and present projects and activities including contamination caused by the East Tailings Management Area, the former Burnt Timber Mine, and the former MacLellan Mine. This is because the surface water quality models incorporated the results of an extensive multi-year baseline water quality monitoring program (Volume 4 of the EIS, Appendix I), and effects associated with existing and historical projects are, therefore, reflected in the predicted water quality data. Regarding sediment modelling, this medium is not typically modelled for environmental assessments because there is no widely used or established approach to predict changes to sediment quality. Due to the lack of robust sediment modelling approaches and the lack of precedence in environmental assessments, Alamos does not believe sediment modelling is required for the assessment of potential effects. Instead, Alamos is confident that water quality modelling is sufficient to assess whether potential adverse effects are likely to occur to aquatic biota in the downstream receiving environment. i. Parameters identified in Schedule 4 of the MDMER are: arsenic, copper, cyanide, lead, nickel, zinc, total suspended solids (TSS), and radium 226. None of these water quality parameters were predicted to exceed the authorized limits in Schedule 4 of the MDMER in Farley Lake during any Project phase, including the Upper-Case model scenario which used the 95th percentile geochemistry source terms and the 95th percentile background water quality data as inputs (i.e., unlikely, worst-case scenario). Similarly, no exceedances of short-term (i.e., acute) Canadian Water Quality Guidelines for the Protection of Aquatic Life (CWQG-FAL), Manitoba Water Quality Standards, Objectives, and Guidelines for the Protection of Aquatic Life (MWQSOG-FAL), or Schedule 4 limit of the MDMER were predicted to occur in the MacLellan site collection pond during any Project phase in the Expected Case or Upper-Case scenarios. Total suspended solids (TSS) concentrations were not modeled. However, compared to the other parameters on Schedule 4 of the MDMER, TSS is the water quality parameter that can be most effectively controlled (e.g., settling ponds, flocculants) and is least likely to result in

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	chronic or acute toxicity to fish and aquatic biota, particularly in a lake where suspended sediments can quickly settle or a river where suspended sediments can quickly disperse. Although modeling suggests that it is highly unlikely that any of the parameters listed in Schedule 4 of the MDMER will be exceeded at any time during the Project, the ecological risks to fish and aquatic biota in the Keewatin River and Farley Lake downstream of the proposed effluent discharge locations due to exceedances of the Authorized Limits of Deleterious Substances concentrations listed in Schedule 4 of the MDMER are dependent on: 1) the toxicity of the parameter(s) given potentially confounding chemistry in the receiving environment (e.g., toxicity of copper is dependent on pH, hardness, temperature, and dissolved organic carbon); 2) the sensitivity of the fish and aquatic biota to the parameter(s); 3) the location and timing of the effluent discharge in relation to sensitive or productive habitat; 4) duration of the exposure to the parameter(s); and 5) the spatial extent of the mixing zone downstream of the effluent discharge location. In the Keewatin River, the mixing zone is expected to be short (e.g., <100 m) because the volume of the Keewatin River is orders of magnitude larger than the maximum predicted effluent volume and because the effluent discharge will be located immediately upstream of a large, swift-flowing cascade which will quickly mix (i.e., dilute) the effluent discharge with river water. Therefore, risks to fish and aquatic biota in the Keewatin River from any exceedance of Schedule 4 MDMER effluent limits would be restricted to a very small area immediately adjacent to the end of the pipe. In Farley Lake, the mixing zone is expected to include a portion of the western basin. This area will have a relatively large volume of water in comparison to the effluent discharge volume expected at the Gordon site (i.e., large initial dilution capacity) but, unlike the Keewatin River, will not result in the quick dispersion of effluent. As a result, fish and aquatic biota in the western basin of Farley Lake would be exposed to water with increasingly concentrated parameters (potentially including those listed on Schedule 4 of the MDMER) if the effluent volume exceeds the ability of wind-generated currents to disperse effluent throughout the lake. While such a scenario could result in lethal or sub-lethal effects to fish and aquatic biota in Farley Lake, the likelihood of such a scenario is remote for reasons explained above. The criteria and parameters that would trigger treatment measures (following retest confirmation) include, but are not necessarily limited to, exceedances of effluent concentration limits for parameters listed on Schedule 4 of the MDMER. Mitigation measures that could be implemented in the unlikely event that water quality in the collection ponds is found to exceed these limits are: • Treatment of contact water with treatment technologies selected based on the concentration of the parameters of concern (e.g., coagulation/flocculation and sedimentation or filtration, ion exchange, chemical precipitation and/or biological treatment).

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	• Piping of contact water from the Gordon site further downstream to waterbodies (e.g., Ellystan Lake) or watercourses (i.e., Hughes River) with greater assimilative capacity. A description of follow-up and adaptive management planning for potential changes in water quality due to construction, operation, closure/decommissioning of the Project is provided in the response to IAAC-108.
Attachment:	No

RESPONSE TO IAAC-111

ID:	**IAAC-111**
Expert Department or Group:	NRCan-47 NRCan-49
Guideline Reference	6.4 Mitigation measures
EIS Reference	5.2.6 Geochemistry 8.4 Assessment of Residual Environmental Effects on Groundwater 20.1 Summary of Changes to the Environment, Potential Effects, Mitigation and Residual Effects Table 20A-1
Information Request:	a. Provide details of the best available treatment technology and techniques economically achievable for phosphorus, fluoride and selenium that will be used at both sites. i. Identify mitigation measures, and describe the criteria and parameters that would trigger treatment measures for phosphorous, fluoride and selenium.
Response:	a. Potential changes to groundwater quantity and quality are predicted and assessed in Volume 1, Chapter 8 of the Environmental Impact Statement (EIS). Potential changes to surface water quantity and quality are predicted and assessed in Volume 1, Chapter 9 of the EIS. Both groundwater and surface water quantity and quality are quantitively predicted using industry-standard models. Effects to fish and aquatic biota due to changes in water quality (including potential effects related to fluoride exposure to fish and benthos) were assessed in Volume 2, Chapter 10, Section 10.2.4.2 of the EIS. Characterization of potential residual effects of the Project on fish and aquatic resources due to potential changes in fish habitat and changes in fish health, growth, and survival are summarized in Volume 2, Chapter 10, Section 10.4.3 of the EIS. Phosphorus and fluoride were identified as parameters of potential concern (PoPCs) at the Gordon site. However, neither PoPC is predicted to occur at a high enough concentration to cause lethal or sub-lethal effects to fish or aquatic biota, or in the case of phosphorus, cause eutrophication of Farley Lake. Phosphorus was only identified as a PoPC at the Gordon site, and only in West Farley Lake during construction. Predicted mean and maximum phosphorus concentrations in West Farley Lake during construction were 21.3 µg/L and 26.6 µg/L, respectively. The potential for eutrophication in the Keewatin River due to nutrient loading from the wastewater treatment plant was assessed in Volume 2, Chapter 10, Section 10.2.4.2 of the EIS; this discussion is also applicable to Minton Lake. Treatment technologies for phosphorus, fluoride and selenium removal will be evaluated and selected as part of Project detailed design. It is noted that neither phosphorous, fluoride, or selenium are listed on Schedule 4 of the MDMER. In the event that phosphorus treatment is required, a coagulation/flocculation process using a flocculant addition followed by sand ballasted sedimentation or deep bed sand filtration would be evaluated for the detailed design. Fluoride removal can be accomplished using activated alumina adsorption, ion exchange, and/or coagulation/flocculation followed by settling or filtration. The

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various alternatives noted above including the regeneration brine treatment would be reviewed during the detailed design.

If required, options for selenium treatment that would be evaluated include biological treatment filters, insitu biological treatment, ion exchange and zero valent iron precipitation.

i. Criteria that would trigger treatment measures for phosphorus, fluoride, and selenium will be finalized in consultation with ECCC, MCC, and local Indigenous Nations during permitting for the Project. However, Alamos is providing proposed trigger concentrations here only to initiate the discussion about what these triggers should be to intiate additional mitigation measures to protect fish and aquatic biota in Farley Lake and the Keewatin River. Final trigger criteria will be based on chemical loadings necessary to cause chronic or acute toxicologic effects to fish and aquatic biota, the biological end-points for any potential changes in water quality in Farley Lake or the Keewatin River.

- Phosphorus: concentrations that would result in loadings to Farley Lake that would cause the trophic status to change from mesotrophic (i.e., average phosphorus concentrations between 0.010 and 0.035 mg/L; average chlorophyll *a* density between 2.5 and 8.0 μg/L) to eutrophic (i.e., >0.035 mg/L phosphorus; >8.0 μg/L chlorophyll *a*).
- Fluoride: 1.0 mg/L, approximately half of the concentration required for inhibiting growth of the most sensitive freshwater algae (Groth 1975); approximately half the concentration of the 20-day LC$_{50}$ for rainbow trout (Angelovic et al., 1961), approximately one quarter of the 7-day and 21-day growth inhibition threshold for *Daphnia magna* (Dave 1984); and approximately 1/380th of the concentration of the LC$_{50}$ for brook stickleback (Smith et al. 1985) at hardness concentrations typically observed in Farley Lake (i.e., 125-140 mg/L CaCO$_3$)
- Selenium: concentrations that would result in loadings to Farley Lake that would cause mean total selenium concentrations to exceed recently published selenium tissue guidelines (BC MoE 2014):
  - 4 μg/g (dry weight) in whole-body fish tissue
  - 4 μg/g (dry weight) in fish muscle tissue
  - 11 μg/g (dry weight) in fish egg/ovary tissue

Phosphorus is a nutrient that, together with nitrogen and dissolved carbon, control production of phytoplankton (i.e., free-floating algae) in lakes and periphyton (i.e., attached algae in rivers and streams). Increased biological production of phytoplankton in lakes may temporarily provide increased food supply for fish during the open water months but may decrease dissolved oxygen concentrations in winter due to increased biological oxygen demand caused by bacterial decomposition of large volumes of dead algae in winter (i.e., winter kill).

The solubility, and therefore toxicity, of inorganic fluoride is inversely correlated with pH (i.e., increasing solubility with decreasing pH) and water hardness (i.e., increasing solubility with decreasing hardness), and is affected by temperature, the presence of calcium and aluminum ions, and ion-exchange substrates such as clays and humic acid (CCME 2002). The lethal concentrations (LC50) for fish and other freshwater aquatic biota vary greatly in the literature since the toxicity of fluoride is dependent upon many variables, most of which are not controlled in previous laboratory experiments.

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	Selenium is an essential trace-element for all animals; but, at high concentrations, can lead to reproductive deformities in egg-laying animals such as fish and birds (Tan et al. 2016). Selenium concentrations increase in higher trophic level organisms (i.e., biomagnification) and in individual organisms as they grow and age (i.e., bioaccumulation). Therefore, large top-predatory fish species (i.e., northern pike) are typically those that would accumulate the most selenium over their life spans. However, different fish species are more sensitive to selenium than others. For example, slimy sculpins are more sensitive to selenium toxicity than salmonids, such as lake whitefish. **References:** Angelovic, J.W., W.F. Sigler, and J.M. Neuhold. 1961. Temperature and fluorosis in rainbow trout. Jour. Water Pollut. Cont. Fed. 33:371. British Columbia Ministry of Environment (BC MoE). 2014. Ambient Water Quality Guidelines for Selenium Update. Water Protection and Sustainability Branch, Environmental Sustainability and Strategic Policy Division. Dave, G., 1984. Effects of fluoride on growth, reproduction, and survival in Daphnia magna. Comp. Biochem. Physio. 78(2):425-431 Groth, E. 1975. An evaluation of the potential for ecological damage by chronic low-level environmental pollution by fluoride. Fluoride 8(4): 29-38. Smith, L.R., T.M. Holsen, N.C. Ibay, R.M. Block, and A.B. DeLeon. 1985. Studies on the acute toxicity of fluoride ion to stickleback, fathead minnow, and rainbow trout. Chemosphere 14(9):1383-1389.
Attachment:	No

RESPONSE TO IAAC-112

ID:	**IAAC-112**
Expert Department or Group:	IAAC MCCN-17 MCCN-85 SDFN-24
Guideline Reference	4.3 Study strategy and methodology 6.1.1 Atmospheric Environment
EIS Reference	5.2.2 Air Quality and Greenhouse Gases 6.2.1.2 Air Quality 6.2.2.2 Air Quality 18.4.1.1 COPC Concentrations in Environmental Media Volume 5, Appendix A Lynn Lake Gold Project, Air Quality Impact Assessment Technical Modelling Report 3.3.2 Other Measurements 3.3.3 Summary of Baseline Ambient Air Quality Concentrations
Information Request:	a. Provide a clear explanation including a rationale for the criteria used for the selection of the Fort Smith continuous monitoring station in the Northwest Territories as to why it is representative of the baseline concentrations of NO_2, CO, and SO_2 in the Project LAA. i. Identify how the information was used to represent the conditions in the LAA, provide the margins of error and other relevant statistical information, such as confidence intervals and sources of error, and any assumptions that were made in the selection of this information as a representative baseline. b. Describe how the selection of the Fort Smith monitoring station impacts the assessment for the atmospheric environment, human health, and the assessment of potential impacts to Indigenous Nations.
Response:	a. As described in Volume 1, Chapter 6, Section 6.2.1.2 of the Environmental Impact Statement, baseline ambient air quality concentrations of NO_2, SO_2 and CO were determined based on analysis of monitoring data from other more distant monitoring stations in Manitoba and Northwest Territories because NO_2, SO_2 and CO were not measured during the Project field programs in 2015 and 2016. The draft Guidelines for Air Dispersion Modelling in Manitoba (MCC 2006) state that "if ambient air quality data from a local air monitoring station are not available, then data from a station located in a similar area (e.g., rural or urban) can be considered". Measured ambient concentrations from three continuous monitoring stations in Manitoba (Thompson, Flin Flon and Winnipeg Ellen Street) were compared with measured ambient concentrations at the Fort Smith continuous monitoring station in Northwest Territories. The Thompson and Flin Flon stations are affected (biased) by industrial emissions and the Winnipeg Ellen Street station is affected (biased) by urban and traffic emissions. Therefore, these monitoring stations are not representative of the Project's remote location and lack of major industrial development in the air quality Study Area. The Fort Smith station in the Northwest Territories is representative of the Project location because it is the closest monitoring station in the Northwest Territories to the Project, it experiences similar meteorological conditions, and is in a similar remote location as the Project. There are no other continuous monitoring stations in other provinces and territories

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	that are closer to the Project than Fort Smith and are in similar remote location as the Project with no major industrial development in the region. i. The 90th percentile of hourly measurements for the most recent year (2018) with a complete data record (at least 75% complete) was selected to represent the baseline air quality level for each substance of interest, following the draft Guidelines for Air Dispersion Modelling in Manitoba (MCC 2006) which requires at least one year of collected ambient air quality monitoring data to be analyzed. The 90th percentile of measurements is considered adequate to account for variability in the baseline due to anthropogenic or unusual local sources. Baseline concentrations for averaging periods greater than one hour (8-hour, 24-hour, annual) were calculated from the hourly measurements after removing hourly values greater than the 90th percentile. b. Given the representativeness of Fort Smith monitoring station for the Project location (per a. above), it is Alamos' opinion that the baseline air quality conditions determined based on ambient air monitoring data from Fort Smith provide the most accurate representation of the incremental changes in ambient air quality in the LAA/RAA due to the Project. **Reference:** MCC. 2006. Draft Guidelines for Air Dispersion Modelling in Manitoba. Manitoba Conservation and Climate (MCC), formerly Manitoba Conservation. Programs Division, Air Quality Section. November 2006. Available at: https://www.gov.mb.ca/sd/pubs/climate-air-quality/mb-air-dm-guidelines.pdf. Last accessed on January 14, 2021.
Attachment:	No

RESPONSE TO IAAC-113

ID:	**IAAC-113**
Expert Department or Group:	IAAC
Guideline Reference	6.1.1 Atmospheric Environment
EIS Reference	6.2.1.2 Air Quality 6.2.2.2 Air Quality 6.5.1 Project Residual Effects Likely to Interact Cumulatively Volume 4, Appendix A Air Quality Baseline Technical Data Report 4.2 Field Data Collection 5.1 Key Considerations and Findings
Information Request:	a. Describe the residential, industrial, commercial, and natural environmental sources (direct and indirect) that were considered in the determination of the baseline for air emissions. Include specific activities (i.e., human activity types and the use of unpaved roads) and their associated locations in relation to the Project, and note whether sources are significant contributors to air emissions.
Response:	a. As described in Volume 1, Chapter 6, Section 6.5.1 of the Environmental Impact Statement (EIS), physical activities in the local assessment area (LAA) include mineral exploration, water and waste projects, residential and community development, infrastructure development, traditional land and resource use, and recreation activities. Mineral exploration activities in Lynn Lake and the surrounding area include claim staking and advanced exploration. Claim staking activities have negligible air emissions. Advanced exploration activities may include drilling, surface stripping, excavation, ground geophysics, downhole geophysics, and geochemistry. Air emissions (primarily PM emissions) associated with advanced exploration are short in duration and much smaller in magnitude than Project emissions. Air emissions (primarily PM emissions) from land disturbance activities associated with infrastructure development, and residential and community development are short in duration and much smaller in magnitude than Project emissions (Volume 1, Chapter 6, Section 6.5.1 of the EIS). Activities such as traditional land and resources use, hunting, outfitting, trapping, fishing, and recreation activities have negligible air emissions. The baseline ambient concentrations provided in Volume 1, Chapter 6, Section 6.2 of the EIS account for active projects and physical activities that are sources of air emissions (i.e., residential, industrial, commercial, and natural environment) in the LAA. Baseline ambient air concentrations were determined based on analysis of ambient air quality monitoring data from local monitoring of $PM_{2.5}$, PM_{10} and dust fall conducted during the air quality baseline field programs in 2015 and 2016. Additionally, baseline ambient air quality concentrations of NO_2, SO_2 and CO were determined based on analysis of monitoring data from a more distant representative ambient air quality monitoring station (Fort Smith in the Northwest Territories), as these parameters were not measured during the LLGP field programs in 2015 and 2016. The draft Guidelines for Air Dispersion Modelling in Manitoba (MCC 2006) states that "if ambient air quality data from a local air monitoring station are not available, then data from a station located in a similar area (e.g., rural or urban) can be considered".

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	The ambient air quality in Fort Smith is generally very good. There are no major industrial activities in and around Fort Smith. Measured ambient air concentrations of NO_2, CO and SO_2 in Fort Smith in the last five years (2014-2018) were well below the ambient air quality criteria (NWT ENR 2018). The primary sources of NO_2 and CO emissions in Forth Smith are residential and commercial heating and idling vehicles, with short-term influences of vehicles traffic in peak hours (NWT ENR 2018). There are no major industrial sources of SO_2 emissions in the region and therefore, measured ambient air SO_2 concentrations are extremely low (NWT ENR 2018). The Fort Smith monitoring station is representative of the Project location because it is located in a similarly remote area with no major industrial development and with similar meteorological and topographical conditions. **References:** MCC. 2006. Draft Guidelines for Air Dispersion Modelling in Manitoba. Manitoba Conservation and Climate (MCC), formerly Manitoba Conservation. Programs Division, Air Quality Section. November 2006. Available at: https://www.gov.mb.ca/sd/pubs/climate-air-quality/mb-air-dm-guidelines.pdf. Last accessed on January 14, 2021. NWT ENR. 2018. Northwest Territories Air Quality Report 2018. Northwest Territories (NWT) Environment and Natural Resources (ENR). Available at: https://www.enr.gov.nt.ca/sites/enr/files/resources/2018_air_quality_report_v6.pdf. Last accessed on February 19, 2021.
Attachment:	No

RESPONSE TO IAAC-114

ID:	**IAAC-114**
Expert Department or Group:	ECCC-02 MCCN-89
Guideline Reference	6.1.1 Atmospheric Environment 6.5. Significance of residual effects
EIS Reference	6.2.2.1 Climate and Meteorology Figure 6A-1 18.7.1 Significance of Project Residual Effects
Information Request:	a. Verify and describe the accuracy of Figure 6A-1 (and associated text in Section 6.2.2.1) reporting that 0% of wind data is considered to be calm (<1 m/s). If it is verified the identified wind data is accurate, clarify how it was determined that 0% of wind data is considered calm. b. Indicate whether the correct wind data was appropriately captured in the atmospheric dispersion models used to determine changes to air quality. i. If incorrect data was used, update the atmospheric dispersion models with the appropriate wind data and subsequently, update the effects assessment for atmospheric environment. Describe any changes to the exceedances of criteria air contaminants (CACs) and contaminants of potential concern (COPCs) noted in the EIS and the timeframes for the anticipated exceedances.
Response:	a. Calm winds (< 1 m/s or 4 km/h) are not recorded at Lynn Lake Airport climate station because low winds less than 1 m/s are below the measurement threshold of the anemometer. During periods of calm winds, the data is often reported as missing, since both the wind speed and wind direction are not defined or are highly uncertain. The hourly wind data from Lynn Lake Airport for the period of 2015 to 2018 includes: • 647 hours with reported 0 km/h wind speed and missing wind direction, and • 4,306 hours with both wind speed and wind direction missing. The 647 hours with reported wind speed of 0 km/h and missing wind direction, equivalent to 1.85% of the 4-year period (2015 to 2018), were considered periods of calm winds. The 4,306 hours with both wind speed and wind direction missing were considered missing data. Figure 6A-1 in Chapter 6 of the Environmental Impact Statement (EIS) has been updated to include the 1.85% calm winds. The updated figure is Figure IAAC-114-1 attached to this response. b. The CALMET® diagnostic meteorological model (Scire et al. 2000a) was used to provide three-dimensional hourly meteorological data (winds, temperatures and turbulence) for a five-year period (2012-2016) required for the CALPUFF® transport, dispersion, and deposition model (Scire et al. 2000b; 2011). CALMET® model used mesoscale meteorological data created with the WRF® mesoscale prognostic model and incorporated surface meteorological observations from Lynn Lake Airport. The wind rose derived for the Project from the CALMET® model indicates dominant winds from northwest, west, north and east. A comparison of the wind roses of measured and predicted (based on WRF® and CALMET®) surface winds at Lynn Lake Airport for the five-year model period (2012-2016) is presented

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	in Volume 5, Appendix A, Attachment D, Figure D 2. Figure D-2 shows that there is a general agreement between the measured and predicted wind roses, both indicating predominant winds from northwest, west, north and east, and with most frequent wind speeds between 2 m/s and 4 m/s. The five-year meteorological data created with WRF® and CALMET® is therefore viewed as being representative of the wide range of weather conditions that could occur in the region. i. The five-year meteorological data (2012-2016) created with the WRF® and CALMET® meteorological models is representative of the wide range of weather conditions that could occur in the region and is appropriate for use in the dispersion modelling of Project emissions. Therefore, no update to the atmospheric dispersion model is required. **References:** Scire J.S., F.R. Robe, M.E. Ferneau and R.J. Yamartino. 2000a. A User's Guide for the CALMET Meteorological Model (Version 5). Earth Tech Inc. January 2000. Available at: http://www.src.com/calpuff/download/CALMET_UsersGuide.pdf. Last accessed on January 20, 2021. Scire, J.S., D.G. Strimaitis and R.J. Yamartino. 2000b. A User's Guide for the CALPUFF Dispersion Model (Version 5). Earth Tech Inc. January 2000. Available at: http://www.src.com/calpuff/download/CALPUFF_UsersGuide.pdf. Last accessed on January 20, 2021. Scire, J.S., D.G. Strimaitis and R.J. Yamartino. 2011. CALPUFF Modelling System Version 6. User Instructions. Earth Tech Inc. April 2011. Available at: http://www.src.com/calpuff/download/CALPUFF_Version6_UserInstructions.pdf. Last accessed on January 20, 2021.
Attachment:	Appendix A, Attachment IAAC-114

RESPONSE TO IAAC-115

ID:	**IAAC-115**
Expert Department or Group:	HC-01 IAAC Conformity Review (Round 2) CR-10
Guideline Reference	3.0 Project Description 3.2.3 Spatial and temporal boundaries 6.1 Project setting and baseline conditions 6.1.1 Atmospheric Environment 6.2.1 Changes to the atmospheric environment 6.3.4 Indigenous peoples
EIS Reference	6.4.1.4 Project Residual Effects Tables 6-21 and 6-22 Volume 5, Appendix A Lynn Lake Gold Project, Air Quality Impact Assessment Technical Modelling Report, Appendix G Maps G-1 to G-25
Information Request:	a. Provide complete contour maps for air pollutant COPCs, including: i. predictions within the previously omitted buffer zones (i.e., 300 m) directly adjacent to PR 391; ii. separate maps for baseline, construction and operational phases of the Project, and cumulative or future development. Provide a rationale for excluding any Project phase; iii. contour lines for relevant standards (e.g., Canadian Ambient Air Quality Standards [CAAQS]); and iv. identifiers for all receptor sites, respectively, as was done for the assessment of noise and vibration (EIS Volume 5, Appendix C, Map 5). Clarify the difference between the five categories of human receptors on Maps G1 to G25 of EIS Volume 5 (e.g., residences, trapping areas, etc.). b. Provide a table with maximum predicted concentrations of CACs and COPCs at all identified receptor sites, and highlight those concentrations that exceed relevant standards (e.g., CAAQS).
Response:	a. In relation to contour maps for air pollutant COPCs: i. The concentration contour maps for Project operation are presented in Volume 5 of the EIS, Appendix A, Attachment G (Map G-1 to Map G-25). Maps G-1 to G-25 were updated to show predicted concentrations within the previously omitted buffer zone (i.e., 300 m) directly adjacent to Provincial Road (PR) 391. The revised maps are Map IAAC-115-1 to Map IAAC-115-25 attached to this response. The predicted concentrations for Project operation presented on Map IAAC-115-1 to Map IAAC-115-25 include all emission sources during Project operation, including peak truck traffic along PR 391 for hauling ore from the Gordon to the MacLellan site. **Errata** There was an error in the processing of model results for annual average dustfall deposition during Project operation and consequently Map G-24 is incorrect. Map G-24 has been revised and replaced by the correct Map IAAC-115-24. ii. Baseline Conditions Baseline emissions were not modelled because of the remote location of the Project and the absense of industrial activities in the air quality local

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	assessment area (LAA). Baseline concentrations were determined based on analysis of ambient air quality monitoring data from the air quality baseline field programs in 2015 and 2016 and from more distant representative ambient air quality monitoring stations. This is an approved approach in the draft Guidelines for Dispersion Modelling in Manitoba (MCC 2006) and in the dispersion modelling guidelines from other provinces such as Ontario and Alberta. Project Construction Project construction emissions were not modelled because construction emissions are less than emissions during operation and therefore, the resulting maximum ambient concentrations during construction will be less than the maximum predicted ambient concentrations during operation. As presented in Volume 5, Appendix A, the dispersion model plan was presented both to Environment and Climate Change Canada (ECCC) and Manitoba Sustainable Development (MSD) before commencing the modelling. ECCC requested that emissions from construction be quantified and compared to Project emissions to demonstrate that construction emissions do not need to be modeled. The total annual construction and pre-production emissions for the worst-case construction year were compared with the total annual Project operation emissions to demonstrate that construction emissions do not need to be modelled in Volume 5, Appendix A. Project Operation Project operation emissions were modelled for the worst-case year of operation (Year 2 for Gordon site and Year 7 for MacLellan site). The concentration contour maps for Project operation are presented in Volume 5 of the EIS, Appendix A, Attachment G (Map G-1 to Map G-25), including maps corresponding to the Canadian Ambient Air Quality Standards (CAAQS). Concentration contour maps presented in Attachment G are limited to the substances and averaging periods for which maximum predicted concentrations are greater than 10% of the AAQC. Cumulative Air Quality Assessment There are no future reasonably foreseeable emission sources that could interact with Project emissions and therefore cumulative air quality assessment is not warranted. iii. The concentration contour maps for Project operation are presented in Volume 5 of the EIS, Appendix A, Attachment G (Map G-1 to Map G-25), including maps corresponding to the NO_2 CAAQS (Maps G-2, G-3 and G-5), the SO_2 CAAQS (Maps G-9 and G-10) and the $PM_{2.5}$ CAAQS (Maps G-21 and G-22). iv. Ambient concentrations and dustfall for Project operation were predicted at receptor grid points in the LAA and 160 special receptor locations representing human receptors, Potential Indigenous Receptor sites and the permanent worker camp. An identifier and a description of the 160 special receptors is presented in Table IAAC-115-1. Map 6-1 (EIS Chapter 6) has been updated to include the identifiers for all special receptors. The updated map is presented as Map IAAC-115-26. The special receptors on Map 6-1 and the updated Map IAAC-115-26 are grouped into four categories to make it easier to locate individual receptors. Three of the categories (Lynn Lake Receptors, Black

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	Sturgeon Reserve, Work Camp) indicate the receptor general location. The “Potential Indigenous Receptor” category indicates a potential location of a traditional land use site. Due to the length of time required to conduct the air quality modelling, Indigenous receptors were selected early in the assessment process and represent potential receptor locations rather than individual use sites. The “Human Receptor” category indicates a special receptor (residence, recreational or commercial site) that is located outside of Lynn Lake and Black Sturgeon Reserve. b. Maximum predicted concentrations at the 160 special receptor locations for Project operation are provided in Table IAAC 115-2 (attached to this response) for substances and ambient air quality criteria (e.g., CAAQS) that are evaluated in the human health risk assessment (EIS Chapter 18), including NO_2, SO_2, HCN, $PM_{2.5}$ and DPM. The maximum predicted concentrations include the baseline concentration contribution. Maximum predicted concentrations at special receptors in Table IAAC-115-2 that exceed the relevant ambient air quality criteria (e.g., CAAQS) are highlighted in bold text and shaded cells. Table IAAC-115-2 include predicted concentrations within the previously omitted buffer zone (i.e., 300 m) directly adjacent to PR 391. The predicted concentrations for Project operation presented in Table IAAC-115-2 include all emission sources during Project operation, including peak truck traffic along PR 391 for hauling ore from the Gordon to the MacLellan site. As described in response a.ii., baseline and construction emissions were not modelled and therefore, tables with maximum ambient concentrations for these phases are not presented.
Attachment:	Appendix A, Attachment IAAC-115

RESPONSE TO IAAC-116

ID:	**IAAC-116**
Expert Department or Group:	CCN-38 SDFN-28 SDFN-45
Guideline Reference	3.2.1 Changes to the environment 3.2.3 Spatial and temporal boundaries 6.1.9 Indigenous peoples 6.2.1 Changes to the atmospheric environment
EIS Reference	6.0 Assessment of Potential Effects on The Atmospheric Environment Map 6-1
Information Request:	a. Describe how Indigenous receptors were identified for the assessment of effects on atmospheric environment. b. Clarify how community knowledge, Aboriginal traditional knowledge, current or traditional land and resource use by Indigenous Nations were considered in the selection of representative sites and state any limitations in the selection of the receptor sites for the assessment. c. Provide rationale for the selection of trapping areas as the receptor locations, and clarify how these receptors were deemed to be applicable for all Indigenous Nations. d. Clarify, including a rationale, as to the determination that no sensitive receptors are within the Project Boundary. e. If additional receptors are identified through engagement, update the assessment of effects to the atmospheric environment to include them. Provide updated maps to depict any additional receptors that are identified during engagement activities.
Response:	a. Information provided through the Indigenous engagement program for the Project, including Project-specific traditional land and resource use (TLRU) studies, as well as a review of publicly available TLRU information sources, was used to select receptor locations relative to current use of lands and resources for traditional purposes. Through engagement, Alamos learned of active trapping and fishing areas and identified potential receptors accordingly to characterize air quality at locations where Indigenous peoples are likely to practice additional harvesting. Modelling predicts the concentration and deposition patterns for substances of interest based on data gathered at monitoring stations. b. Receptor locations in the Project area are locations that were identified by participating Indigenous Nations as places used for hunting, trapping, fishing, plant gathering, camping/shelter as well as cultural and spiritual areas. The receptor locations are identified on Map 18-1. As noted in Volume 1, Chapter 6, Section 6.1.2 of the EIS, due to the length of time required to conduct air quality modelling, Indigenous receptors were selected early in the assessment process and represent potential receptor locations rather than individual use sites. Alamos' conservative approach to assessing effects on current use assumes that these receptors are applicable year-round to anyone who exercises Indigenous rights through traditional activities and harvesting in the area, irrespective of which Indigenous Nation they are from. c. Trapping areas, including commercial traplines, are places in the LAA and RAA where it is expected that Indigenous harvesters may be present based on Project-specific TLRU studies, regularly and in a patterned way, including overnight stays in cabins and camps, several of which were selected as potential receptors, as

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	described in part a. above, especially throughout the winter months. As such, there is a potential for sensitive receptors to occur in these areas. d. Both the MacLellan and Gordon sites are on previously disturbed, historical mine sites. Project-specific traditional land and resource use (TLRU) indicated a portion of a historical trail that overlaps the MacLellan site Project Development Area (PDA) and, there is a potentially sensitive receptor if anyone uses this trail. However, during Project construction, operation, and decommissioning, access to the Project site will be restricted. No traditional harvesting or other cultural activities will occur within the Project boundaries, and therefore, no sensitive receptors related to current use of lands and resources for traditional purposes are anticipated. Alamos is committed to ongoing engagement with Indigenous Nations affected by the Project. No new sensitive receptors have been identified, and therefore additional assessment is not required. e. Indigenous input from engagement activities since May 2020 was incorporated into the supplemental filing to the EIS that was provided to IAAC in March 2021. No new sensitive receptors have been identified and therefore no changes to the conclusions of the EIS are proposed. In addition, direct responses to these comments from Chemawawin Cree Nation and Sayisi Dene First Nation (CCN-38, SDFN-28, SDFN-45) were provided to the Nations on February 2, 2021, and February 8, 2021 respectively, incorporating the information in the response above, and seeking additional comment. Alamos' engagement with Indigenous Nations will be ongoing for the life of the Project.
Attachment:	No

RESPONSE TO IAAC-117

ID:	**IAAC-117**
Expert Department or Group:	CCN-29 CCN-30 CCN-31 CCN-32 CCN-33 CCN-34 CCN-35 CCN-36 CCN-37 IAAC SDFN-34 SDFN-35 SDFN-36 SDFN-37 SDFN-38 SDFN-39 SDFN 40 SDFN-41 SDFN-42
Guideline Reference	3.2.1 Changes to the environment 3.2.3 Spatial and temporal boundaries 6.2.1 Changes to the atmospheric environment 5.0 Engagement With Indigenous Nations and Concerns Raised
EIS Reference	6.1.4.1 Spatial Boundaries 6.4.1.4 Project Residual Effects
Information Request:	a. Describe how the spatial boundaries (PDA, LAA, and RAA) consider current or traditional land and resource use by Indigenous Nations, including ecological, technical, social, and cultural aspects. b. Considering the response to IAAC-116, describe the selection of receptor points for exceedances of NO_2, TSP, and PM_{10}. i. Describe limitations of using the selected receptors in conclusions on impacts from the exceedances. ii. Describe the rationale as to why the conclusion is that there are no sensitive receptors around the Project Boundary in areas of the identified exceedances for NO_2, CO, and SO_2. c. If additional receptors are identified and/or defined through engagement activities, describe the potential for exceedances at those receptor locations. Update the effects assessment for the relevant VCs (i.e., atmospheric environment, human health, Indigenous Peoples, etc.). Describe any additional mitigation measures and/or follow-up as required.
Response:	a. As described in Volume 1, Chapter 6, Section 6.1.4.1 of the Enviornmental Impact Statement (EIS), the Project Development Areas (PDAs) encompass the immediate area in which Project activities and components may occur at each site plus a 30 m buffer and are the anticipated areas of direct physical disturbance associated with construction and operation of the Project (i.e., the Project footprint). During Project construction, operation, and decommissioning/closure, access to the Project will be restricted. No traditional harvesting or other cultural activities will occur within the Project boundaries, and therefore, no sensitive receptors related to current use of lands and resources for traditional purposes are anticipated in the PDA. The local assessment area (LAA) and regional assessment area (RAA) for air quality were established to comply with provincial regulatory requirements and to capture air quality effects of the specific components being assessed. Both the LAA and RAA are defined as a 50 km by 28 km area that is centered on the Project and includes both the Gordon and MacLellan sites. This modelling domain is large enough to predict ground-level concentrations for comparison with the relevant regulatory criteria for ambient air quality. Indigenous receptor locations within the LAA were selected based on information provided through the Indigenous engagement program for the Project, including Project-specific traditional land and resource use (TLRU) studies, as well as a review of publicly available TLRU information sources. Through engagement, Alamos learned of active trapping and fishing areas and identified potential

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	receptors accordingly to characterize air quality at locations where Indigenous peoples are likely to practice additional harvesting. b. With respect to the selection of receptor points for exceedances of NO_2, TSP, and PM_{10}: i. Potential Indigenous receptor locations in the LAA are locations that were identified by participating Indigenous Nations as places used for hunting, trapping, fishing, plant gathering, camping/shelter as well as cultural and spiritual areas. As noted in Volume 1, Chapter 6, Section 6.1.2 of the Environmental Impact Statement (EIS), due to the length of time required to conduct air quality modelling, Indigenous receptors were selected early in the assessment process and represent potential receptor locations rather than individual use sites, and as such not all participating Indigenous Nations had shared information regarding traditional land use or recommended receptor locations. The potential Indigenous receptor locations are identified on Map 6-1 (Volume 1, Chapter 6 of the EIS). Alamos' conservative approach to assessing effects on current use assumes that these receptors are applicable year-round to anyone who exercises Indigenous rights through traditional activities and harvesting in the area, irrespective of which Indigenous Nation they are from. As described in Volume 1, Chapter 6, Section 6.4.1.4 of the EIS, there are three Potential Indigenous Receptors (Potential Indigenous Receptor 24, Potential Indigenous Receptor 27 and Potential Indigenous Receptor 28) in the predicted exceedance area for the 1-hour NO_2 CAAQS, the 24-hour TSP Manitoba AAQC and the 24-hour PM_{10} Manitoba AAQC at the Gordon site, and four Potential Indigenous Receptors (Potential Indigenous Receptor 33, Potential Indigenous Receptor 36, Potential Indigenous Receptor 37 and Potential Indigenous Receptor 38) in the predicted exceedance area at the MacLellan site. There were no other Potential Indigenous Receptors identified/located in the predicted exceedance areas. ii. As described in Volume 1, Chapter 6, Section 6.4.1.4 of the EIS, the predicted 1-hour average NO_2, 1-hour average CO and 1-hour average SO_2 concentrations greater than the corresponding Manitoba AAQC occur for a maximum of two hours per year and are limited to the northeast Project Boundary at the Gordon site and the south Project Boundary at the MacLellan site (only for 1-hour NO_2). The locations of these areas of exceedance do not overlap with the Potential Indigenous Receptors identified within the Project Boundary (Map 6-1 in the EIS). c. Indigenous input from engagement activities since May 2020 was incorporated into the supplemental filing to the EIS that was provided to IAAC in March 2021. No new sensitive receptors have been identified and no changes to the conclusions of the EIS are therefore proposed. In addition, a direct response to these comments from Chemawawin Cree Nation and Sayisi Dene First Nation (CCN-39, CCN-40, CCN-41, SDFN-46, SDFN-47, SDFN-49) were provided to the Nations on February 2, 2021, and February 8, 2021 respectively, incorporating the information in the response above, and seeking additional. Alamos' engagement with Indigenous Nations will be ongoing for the life of the Project.
Attachment:	No

RESPONSE TO IAAC-118

ID:	**IAAC-118**
Expert Department or Group:	CCN-27 SDFN-31 SDFN-44
Guideline Reference	6.2 Predicted changes to the physical environment 6.3.4 Indigenous peoples 6.4 Mitigation measures
EIS Reference	6.4.1.2 Project Pathways
Information Request:	a. Provide links between Project-specific emissions and their different potentials to contribute to odour. Assess the effects to VCs from odour. b. Identify how odour from Project emissions has the potential to contribute to the qualitative sensory disturbance to Indigenous Nations, including perceptions and avoidance behaviours in relation to a perceived negative impact on air quality. Describe the pathway of effects from sensory disturbance to impacts to rights, including the potential implication of avoidance behaviours. c. Provide mitigation measures to address potential adverse impacts of odours from Project-specific emissions and describe the associated follow-up to verify the effectiveness of mitigation measures.
Response:	a. Diesel combustion exhaust from off-road mining equipment and vehicles is the primary source of odour associated with mining activities. The primary odour-causing substance (i.e., odourant) in diesel combustion exhaust is nitrogen dioxide (NO_2). Other Project emissions and/or activities are unlikely to contribute substantively to Project-related odour. An odour assessment of NO_2 emissions during Project operation was conducted to determine potential odour effects from the Project's NO_2 emissions on the Air Quality VC. See b. (below) for the potential contribution of odour from Project emissions on the qualitative sensory disturbance to Indigenous Nations. The perception of odour is subjective, and each individual has a slightly different level of sensitivity. Hence, odour thresholds for odourants often span a wide range of concentrations that can depend on the approach used to define and determine the thresholds. The following are typical odour thresholds: • The minimum perceptible threshold is the lowest concentration at which an odour is noticed by a sensitive member of the population. • The detection threshold is the lowest concentration at which an odour is noticed by a specified percentage of the population. • The recognition threshold is the lowest concentration at which the specific character of an odour can be identified by a specified percentage of the population. Recognition thresholds can typically be 2 to 10 times greater than the detection thresholds (US EPA 1992). Table IAAC-118-1 identifies the detection and recognition thresholds adopted for the odour assessment for NO_2. Odour events are associated with short periods less than 1-hour in duration. For this assessment, a 3-minute average period is assumed sufficient to detect an odour. A scaling factor of 2.3, based on a formula converting 1-hour average concentrations to a 3-minute average from Ontario Ministry of Environment and Climate Change (MOECC) Air Dispersion Modelling Guideline (ON MOECC 2016),

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	is used to adjust the 1-hour predictions in the model for peak concentrations that can occur over shorter periods. Regulatory agencies have adopted odour guidelines with compliance frequencies that range from 98.0% to 99.9% (Nicell 2009). This assessment provides concentration contours that correspond to 99.5% compliance (NO_2 concentration exceeds the odour threshold for 44 hours per year) for indicating where odours could potentially occur, based on Ontario MOECC Technical Bulletin for modelling contaminants with odour based ambient air quality standards (ON MOECC 2008). The Ontario MOECC Technical Bulletin states that it is acceptable for an odour threshold to be exceeded at a human receptor less than 0.5% of the time, which corresponds to approximately 44 hours per year. This compliance frequency is within the generally accepted guidelines (Nicell 2009). The CALMET/CALPUFF® model system (Scire et al. 2000a; 2000b; 2011) was used to determine the effect of Project operation emissions on ambient air quality. The maximum predicted 1-hour NO_2 concentrations in the air quality local assessment area (LAA) during Project operation are provided in Chapter 6 of the EIS. The frequencies of peak (3-minute average) NO_2 concentrations greater than the odour detection threshold (226 µg/m³) and odour recognition threshold (734 µg/m³) were used to identify the potential areas where odour could occur due to NO_2 emissions. The potential areas where odour could occur due to NO_2 emissions during Project operation are shown on Map IAAC-118-1. Two areas are displayed: • Area encompassed by the detection threshold contour (226 µg/m³) with 99.5% compliance (odour events occurring 44 hours per year). This area represents the area where the most sensitive population members might detect an odour. • Area encompassed by the recognition threshold contour (734 µg/m³) with 99.5% compliance (odour events occurring 44 hours per year). This area represents the area where most of the population could detect an odour. The results of the odour assessment for NO_2 emissions during Project operation (Map IAAC-118-1) indicate that: • The model-predicted maximum NO_2 concentrations are less than the NO_2 odour recognition threshold (i.e., threshold at which most of the population could detect an odour) in the air quality LAA. Therefore, it is unlikely that the general population could detect an odour in the air quality LAA due to the Project's NO_2 emissions. • The areas where the predicted peak NO_2 concentrations are greater than the NO_2 odour detection threshold (i.e., areas where the most sensitive population members might detect an odour) are confined to within the Project boundaries at the Gordon and MacLellan sites. • The model predicted maximum NO_2 concentrations at all human receptors and Potential Indigenous Receptors in the air quality LAA are less than the odour recognition thresholds (i.e., threshold at which most of the population could detect an odour) and less than the odour detection threshold (i.e., threshold at which the most sensitive members of the population might detect an odour). b. The model-predicted maximum NO_2 concentrations outside the Project boundaries at the Gordon and MacLellan sites, including all Potential Indigenous Receptors in the air quality LAA, are less than the odour recognition thresholds (i.e., threshold at which most of the population could detect an odour) and less than the odour detection threshold (i.e., threshold at which the most sensitive members of the

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population might detect an odour). Therefore, odour from Project's NO_2 emissions does not have the potential to contribute to a qualitative sensory disturbance to Indigenous Nations, including perceptions and avoidance behaviours in relation to a perceived negative impact on air quality.

c. The mitigation measures to reduce diesel combustion exhaust emissions from construction and mining off-road equipment and vehicles, including NO_2 emissions, are described in Chapter 6 in the EIS. The same mitigation measures are applicable to reducing the potential for odour occurrence from diesel combustion exhaust NO_2 due to Project activities.

The mitigation measures to reduce diesel exhaust emissions from off-road equipment and vehicles that are incorporated in the Project design include:

- Mining off-road equipment used during Project operation will comply with the most stringent (Tier 4) emission standards (i.e., newer equipment manufactured during or after 2014) for off-road diesel engines (ECCC 2005).
- Construction off-road equipment will comply with the most stringent (Tier 4) emission standards for off-road diesel engines (ECCC 2005) to the extent possible and where feasible. The construction fleet will be rented and might include older equipment. Project emissions during construction were conservatively estimated based on Tier 3 emission standards (i.e., older equipment).

Mitigation measures based on best management practices (BMPs) will be implemented to manage and reduce diesel exhaust emissions from off-road equipment and vehicles, including NOx and associated ambient NO_2 concentrations. The following BMPs will be implemented for the management and reduction of diesel exhaust emissions during construction, operation and decommissioning:

- Engines and exhaust systems will be properly maintained to keep construction and mining equipment in good working condition.
- Haul trucks and vehicle idling times will be reduced to the extent possible.
- Cold starts will be limited to the extent possible.

References:

ECCC. 2005. Off-Road Compression-Ignition Engine Emission Regulations. SOR/2005-32. Available at: https://laws-lois.justice.gc.ca/PDF/SOR-2005-32.pdf. Last accessed on January 25, 2021.

ON MOECC. 2008. Technical Bulletin. Methodology for Modelling Assessments of Contaminants with 10-minite Average Standards and Guidelines under O.Reg. 419/05. Ontario Ministry of the Environment and Climate Change (ON MOECC). April 2008.

ON MOECC. 2016. Air Dispersion Modelling Guideline for Ontario [Guideline A-11]. Version 3.0. Ontario Ministry of the Environment and Climate Change (ON MOECC). February 2017.

Scire J.S., F.R. Robe, M.E. Ferneau and R.J. Yamartino. 2000a. A User's Guide for the CALMET Meteorological Model (Version 5). Earth Tech Inc. January 2000.

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Attachment:	Appendix A, Attachment IAAC-118

RESPONSE TO IAAC-119

ID:	**IAAC-119**
Expert Department or Group:	ECCC-03
Guideline Reference	3.2.2 Operation 6.2.1 Changes to the atmospheric environment 6.4 Mitigation measures
EIS Reference	6.4.1.1 Analytical Assessment Techniques 6.4.1.2 Project Pathways 6.4.1.3 Mitigation Volume 5, Appendix A Lynn Lake Gold Project, Air Quality Impact Assessment Technical Modelling Report, Appendix C Table C-4 US EPA AP-42: 13.2.5 Industrial Wind Erosion
Information Request:	a. Confirm that appropriate calculations were used (as described in the reference document, US EPA AP-42: 13.2.5) to estimate fugitive PM from wind erosion of stockpiles. Provide revised tables as needed. b. Verify and describe how all transition points in and out of covered areas (i.e., fine ore stockpile, crushing plant conveyors) are considered as sources for fugitive PM emissions in the predictions presented in the EIS. i. If any transition points were missing in the fugitive PM emissions predictions, provide updated predictions to include any missing transition points and update the effects assessment on the atmospheric environment. Update the effects assessment for other VCs (i.e., human health) as necessary. c. If additional sources of fugitive PM emissions are identified, describe any additional mitigation measures or design features (i.e., fine ore stockpile, crushing plant conveyors) to mitigate fugitive dust emissions.
Response:	a. Table C-4 (Volume 5, Appendix A, Attachment C) lists incorrectly the $PM_{2.5}$ emission factor formula for wind erosion and the units for friction velocity. The correct coefficient in the $PM_{2.5}$ formula is k3=0.075 and the correct units of friction velocity are (m/s). However, wind erosion emissions for Project construction and operation were calculated using the correct emission factor formula (k3=0.075) and the correct friction velocity units (m/s). The emission summary tables for Project construction and operation (Tables 6-13 to 6-20 in the Environmental Impact Statement (EIS) Chapter 6) are correct and do not need to be revised. b. In relation to transition points in and out of covered areas: i. The primary crusher, secondary crusher, and the fine ore stockpile are fully covered and therefore, fugitive dust emissions from these areas are not expected. The primary crusher building is equipped with a dust collector and the secondary crusher building with a wet scrubber, to control PM emissions. PM emissions from the primary crusher dust collector and the secondary crusher wet scrubber were estimated based on an inlet dust loading of 30 g/m^3 and 98% capture efficiency. The connecting conveyors between the primary crusher and the secondary crusher, the secondary crusher and the fine ore stockpile, and the fine ore stockpile and the processing plant are fully enclosed and therefore, fugitive dust emissions from the conveyors transition points are

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	not expected. Therefore, the effects assessment on the atmospheric environment does not need to be updated. c. No additional sources of fugitive dust emissions were identified and therefore, no additional mitigation measures are necessary to mitigate fugitive dust emissions from the crushing plant conveyors or fine ore stockpile.
Attachment:	No

RESPONSE TO IAAC-120

ID:	**IAAC-120**
Expert Department or Group:	ECCC-07 IAAC
Guideline Reference	6.2.1 Changes to the atmospheric environment
EIS Reference	6.4.2 GHG Emissions Volume 5, Appendix A Lynn Lake Gold Project, Air Quality Impact Assessment Technical Modelling Report 4.0 Project Air Emissions 5.0 Project GHG Emissions Appendix F
Information Request:	a. Provide an estimate of the GHG emissions by individual pollutant for the decommissioning phase at both the MacLellan and Gordon sites. i. Provide information in a format and the same level of detail as was done for the construction and operation phases (including tables and a breakdown of activities and pollutants). ii. Provide a justification for the 30% estimate used to as a fraction of the construction GHG emissions. Consider applicable decommissioning timelines, equipment differences and types, as well as any other activities that would contribute to GHG emissions during this phase that would not be applicable during the construction phase. iii. Specify all the considerations incorporated into the analysis and calculation of emissions for the decommissioning phase. b. Using the information in part a, provide the total estimate of GHGs for the Project and present this total by individual pollutant.
Response:	a. Sufficiently detailed engineering information for decommissioning is not available at this time to generate a detailed breakdown of the decommissioning greenhouse gas (GHG) emissions. Alamos estimated that the level of activity for decommissioning will be approximately 30% of the level of construction activity (rationale provided in response b. below). Hence, the decommissioning GHG emissions at the Gordon site (0.46 kilotonnes of carbon dioxide equivalent or kt CO_2e) are 30% of the Gordon site construction GHG emissions (1.53 kt CO_2e) for the equipment used to build on-site infrastructure. The decommissioning GHG emissions at the MacLellan site (3.78 kt CO_2e) are 30% of the MacLellan site construction GHG emissions (12.59 kt CO_2e) for the equipment used to build the on-site infrastructure. b. Table IAAC-120-1 attached to this response summarizes the GHG emissions for decommissioning at MacLellan and Gordon. The estimated GHG emissions for decommissioning at MacLellan and Gordon are 3,778 and 460 tonnes of carbon dioxide equivalent (t CO_2e), respectively. In both cases the decommissioning GHG emissions were estimated to be 30% of the construction emissions for the equipment used to build the on-site infrastructure (e.g., off-road diesel equipment emissions, on-highway truck exhaust emissions, drilling, and blasting) but not including the equipment used during construction for pre-production. The assumption that the decommissioning emissions would be 30% of the construction emissions was based on the professional judgement and experience of Alamos

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	(pers. comm. 2020) based on decommissioning timelines, equipment differences and types, as well as any other activities that would contribute to GHG emissions during this phase that would not be applicable during the construction phase. The total GHG emissions estimated for decommission phase at MacLellan and Gordon are 4,238 t CO_2e. Table IAAC-120-1 also provides a breakdown of the decommissioning GHG emissions by individual pollutant (e.g., CO_2, CH_4 and N_2O). Overall, 96% of the decommissioning GHG emissions are from off-road diesel exhaust. Table IAAC-120-1 is similar to GHG summary Tables F-7 and F-8 presented in Volume 5, Appendix A of the EIS and Appendix F therein. Table IAAC-120-2 attached to this response summarizes the total estimated GHG emissions for the Project for construction, 13-years of operations and decommissioning. Table IAAC-120-2 is similar to GHG summary Table F-12 presented in Volume 5, Appendix A of the EIS and Appendix F therein. The breakdown for the individual GHG pollutants for construction and operation for Gordon and MacLellan is summarized in Tables F-10 and F-11 in Volume 5, Appendix A of the EIS and Appendix F therein. Table IAAC-120-3 attached to this response summarizes the total estimated GHG emissions for the Project for construction, 13-years of operation and decommissioning/closure broken down into the individual pollutants. **Reference:** Personal communication (pers comm). 2020. July 7, 2020 email from Director, Projects for Alamos to Stantec Project Manager estimating the Lynn Lake Gold Project decommissioning GHG emissions to be 25-30% of the construction GHG emissions.
Attachment:	Appendix A, Attachment IAAC-120

RESPONSE TO IAAC-121

ID:	**IAAC-121**
Expert Department or Group:	ECCC-09
Guideline Reference	1.4 Regulatory framework and the role of government 6.2.1 Changes to the atmospheric environment
EIS Reference	6.4.1.2 Project Pathways
Information Request:	a. Describe the regulatory context that will apply to the selection of Tier 3 and Tier 4 electricity generation engines for the Project. b. Describe and compare the emissions that would result from using Tier 3 or Tier 4 engines for electricity generation at the Gordon site, and provide a rationale as to why Tier 3 engines have been used to calculate emissions. c. If Tier 4 engines are chosen, identify any changes to the effects assessment.
Response:	a. The Canadian Off-Road Compression-Ignition (Mobile and Stationary) and Large Spark-Ignition Engine Emission Regulations (the “Regulations”) (SOR/2020-258; ECCC 2020) replaced the Off-road Compression-Ignition Engine Emission Regulations (SOR/2005-32; ECCC 2005) on December 4, 2020. The Regulations set performance-based emission standards for air pollutants from new off-road diesel stationary engines manufactured after June 4, 2021 to align them with the existing emission standards for off-road diesel mobile engines covered in the 2005 regulations. Stationary diesel engines manufactured after June 1, 2021, with displacement below 10 litres per cylinder must meet Tier 4 emission standards for mobile off-road diesel engines. Stationary diesel engines used only for emergencies (e.g., standby generators), stationary engines used in remote locations and stationary fire pumps are exempted from the most stringent Tier 4 emission requirements and must comply with Tier 3 emission standards. A remote location is defined in the Regulations as a geographic area that is serviced neither by: • “An electrical distribution network that is under the jurisdiction of the North American Electric Reliability Corporation or the main Newfoundland and Labrador electrical distribution network; nor • A natural gas distribution network.” The diesel generators at Gordon site are classified as off-road diesel stationary engines in a remote location according to the Regulations and must comply with Tier 3 emission standards (rationale provided in response b.). b. Power for the MacLellan site will be supplied by Manitoba Hydro and power for the Gordon site will be supplied on site via two stationary 300 kW diesel generators (one continuous and one standby). Power distribution at Gordon site will be via 4.16 kV overhead lines, cable tray and underground conduits, with local outdoor type e-houses for transformers and load centres at each point of utilization. The diesel generators at Gordon site are classified as off-road diesel stationary engines in a remote location according to the Regulations because the Gordon site is not serviced by Manitoba Hydro power distribution grid, or a natural gas distribution network. Therefore, the generators at Gordon site are not required to meet Tier 4 emission standards. The selected model for the generators is a Tier 3 certified diesel generator set MTU 6R1600 DS300 and complies with the Regulations.

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	A comparison of the emission rates from the Gordon site continuous generator based on Tier 3 and Tier 4 emission standards is presented in Table IAAC-121-1. Emissions are estimated only for the continuous generator because the standby generator will be used only as a backup generator. Table IAAC-121-1 shows that the generator NOx, DPM and VOC emission rates based on Tier 4 emission standards are 92%, 63% and 43% lower than the emission rates based on Tier 3 emission standards, respectively. There is no change to the CO emission rates because the Tier 3 and Tier 4 emissions standards for CO are the same. There is no change to the SO_2 emission rates because the SO_2 emission rate is based on the amount of sulfur in diesel fuel (15 ppm). Table IAAC-121-1 shows that the diesel generator at Gordon site has a small contribution (less than 8%) to total emissions from Gordon site operation and using Tier 4 engines for the generators will not reduce substantially (less than 6%) the total emissions from Gordon site during operation. c. The diesel generators at the Gordon site have a small contribution (less than 8%) to total emissions from Gordon site operation and using Tier 4 engines will not substantially reduce (less than 6%) the total emissions from Gordon site during operation. Therefore, there is no change to the conclusions of the effects assessment on the atmospheric environment if Tier 4 engines were selected for the diesel generators at Gordon site. **References:** ECCC. 2005. Off-Road Compression-Ignition Engine Emission Regulations. SOR/2005-32. Available at: https://laws-lois.justice.gc.ca/PDF/SOR-2005-32.pdf. Last accessed on February 1, 2021. ECCC. 2020. Off-Road Compression-Ignition (Mobile and Stationary) and Large Spark-Ignition Engine Emission Regulations. SOR/2020-258. Available at: http://gazette.gc.ca/rp-pr/p2/2020/2020-12-23/pdf/g2-15426.pdf#page=490. Last accessed on February 1, 2021.
Attachment:	Appendix A, Attachment IAAC-121

RESPONSE TO IAAC-122

ID:	**IAAC-122**
Expert Department or Group:	ECCC-10
Guideline Reference	6.1.1 Atmospheric Environment 6.2.1 Changes to the atmospheric environment
EIS Reference	6.4.1.2 Project Pathways 6.4.2 GHG Emissions
Information Request:	a. Describe the equipment to be used on site and the associated emission estimates for all phases of the Project, including diesel generators (anticipated to be used for electricity generation at the Gordon site) and individual vehicles and engine descriptions (engine type, engine make/model, model year, power rating, and fuel type). i. Provide the volume of diesel, and its specifications (i.e., sulphur content) to be used in the operation of diesel generators at the Gordon site during construction, operation, and decommissioning phases. ii. Provide assumptions with activity data (hours per day), the emissions factors referenced for the emissions estimates, and the methods used, along with the sample calculations.
Response:	a. A detailed description of emission calculations for Project construction and operation is provided in Volume 5, Appendix A, Attachment C of the Environmental Impact Statement (EIS). A list of the off-road diesel equipment used at the MacLellan and Gordon sites, including equipment type, equipment make/model, applicable tier of emission standards, number of units, engine power rating, hours and days of operation, fuel consumption and engine load factor, is presented in Table C-10 for Project operation and in Table C-26 for Project construction. A list of the trucks and vehicles travelling on the access roads to the MacLellan and Gordon sites and Provincial Road (PR) 391, including truck/vehicle type and number of round trips, is presented in Table C-12 for Project operation and in Table C-27 for Project construction. Power for the Gordon site will be supplied on site via two stationary 300 kW diesel generators (one continuous and one standby). The selected generator model is a Tier 3 certified diesel generator set MTU 6R1600 DS300 as listed in Table C-7. i. The fuel consumption of the diesel generators at the Gordon site is 82 litres per hour (L/h) at 100% power rating as per manufacturer specifications for diesel generator set model MTU 6R1600 DS300. The sulfur content in diesel fuel is limited to 15 mg/kg based on the Canadian Off-Road Compression-Ignition (Mobile and Stationary) and Large Spark-Ignition Engine Emission Regulations (ECCC 2020) for off-road stationary diesel engines below 30 litres per cylinder, effective June 4, 2021. ii. A detailed description of emission calculations for Project construction and operation is provided in Volume 5, Appendix A, Attachment C of the EIS. Exhaust emissions from the off-road diesel equipment are calculated using the Canadian off-road diesel engines emission standards (ECCC 2005) in Table C-1, the off-road diesel equipment parameters in Table C-10 (operation) and Table C-26 (construction), and following Equations C-3 and C-4. Tier 3

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	emission standards are used for off-road diesel equipment during construction and Tier 4 – during operation. Exhaust emissions from the on-road trucks and vehicles travelling on the access roads to the Gordon and MacLellan sites and PR 391 are calculated using the MOVES 2014a emission factors in Table C-2, the on-road trucks and vehicles parameters in Table C-12 (operation) and Table C-27 (construction), and following Equation C-5. Exhaust emissions from the diesel generator at Gordon site are calculated using the emission factors from the manufacturer specifications in Table C-7 and following Equations C-3 and C-4. Emissions are estimated only for the continuous generator because the standby generator will be used only as a backup generator. The selected generator model is a Tier 3 certified diesel generator set MTU 6R1600 DS300 as listed in Table C-7. **Reference:** ECCC. 2020. Off-Road Compression-Ignition (Mobile and Stationary) and Large Spark-Ignition Engine Emission Regulations. SOR/2020-258. Available at: http://gazette.gc.ca/rp-pr/p2/2020/2020-12-23/pdf/g2-15426.pdf#page=490. Last accessed on February 1, 2021.
Attachment:	No

RESPONSE TO IAAC-123

ID:	**IAAC-123**
Expert Department or Group:	ECCC-04
Guideline Reference	4.3 Study strategy and methodology 6.4 Mitigation measures
EIS Reference	6.4.1.3 Mitigation 6.10 Summary of Commitments Volume 5, Appendix A Lynn Lake Gold Project, Air Quality Impact Assessment Technical Modelling Report, Appendix C C.3.2 General Assumptions US EPA AP-42: 13.2.2 Unpaved Roads
Information Request:	a. Explain why a 75% control efficiency for fugitive dust from unpaved haul roads was used. b. Describe how a 75% control efficiency will be achieved and how its continued achievement will be ensured during the life of Project for when roads are not snow covered and any other uncertainties associated with this control efficiency. i. If a 75% control efficiency cannot be achieved continually throughout the life of the Project, provide a scenario for implementation that will realistically be achieved and update the air quality modelling accordingly. If needed, update the effects assessment to VCs, such as human health, with updated inputs from the air quality modelling and provide additional mitigation measures if necessary.
Response:	a. A 75% dust control efficiency on the haul roads and access roads is based on increasing the moisture content of the haul roads and access roads by two times (US EPA 2006). Watering as a best management practice for the Project is described in Volume 1, Chapter 6, Section 6.4.1.3 of the Environmental Impact Statement (EIS). Watering of the unpaved haul roads and access roads increases the moisture content, which in turn causes particles to agglomerate and reduces the likelihood of them becoming suspended when vehicles pass over the surface. The AP-42 Chapter 13.2.2 Unpaved Roads (US EPA 2006) presents a simple bilinear relationship (Figure 13.2.2-2) between the surface moisture ratio (M) and the resulting instantaneous control efficiency due to watering. The surface moisture ratio (M) is defined by the ratio of the surface moisture content of the watered road to the surface moisture content of the uncontrolled road. Based on Figure 13.2.2-2, an increase of the surface moisture content by a factor of two (M=2) results in an instantaneous control efficiency of 75%. b. The control efficiency depends on how fast the road dries after water is applied. The Western Regional Air Partnership (WRAP) Fugitive Dust Handbook (WRAP 2006) suggests regular reapplication of water to maintain the control efficiency. Field measurements of dust emissions generated by scrapers (WRAP 2006) have showed an average control efficiency above 75% approximately 2 hours after watering with an efficiency decay rate of 3% to 14% per hour, equivalent to 5 to 25 hours until the dust mitigation efficiency reduces to 0%. The control efficiency of haul roads and access roads watering will be maintained at 75% by application of water at a minimum frequency of every 8 hours (at every shift change) for a 24-hour work day during summer and increasing the watering frequency in dry

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	summer days and high wind conditions or if measured ambient PM concentrations are in exceedance of the Manitoba AAQC. When roads are not snow covered, chemical dust suppressants will be applied as an alternative option to watering during high wind conditions or if measured ambient PM concentrations are in exceedance of the Manitoba AAQC and if an increase of watering is determined ineffective or unfeasible. i. A dust control efficiency of 75% on the haul roads and access roads will be achieved throughout the life of the Project by application of water at a minimum frequency of every 8 hours during summer and increasing the watering frequency in dry summer days and high wind conditions and if measured ambient PM concentrations are in exceedance of the Manitoba AAQC. Chemical dust suppressants will be applied as an alternative option to watering during high wind conditions or if measured ambient PM concentrations are in exceedance of the Manitoba AAQC and if an increase of watering is determined ineffective or unfeasible. No update to the air quality modelling is necessary. **References:** US EPA. 2006. AP-42 Fifth Edition Compilation of Air Pollutant Emission Factors, Volume 1, Chapter 13.2.2 Unpaved Roads. November 2006. United States Environmental Protection Agency (US EPA). Available at: https://www3.epa.gov/ttn/chief/ap42/ch13/index.html. Last accessed on January 19, 2021. WRAP. 2006. Western Regional Air Partnership Fugitive Dust Handbook. Western Regional Air Partnership (WRAP). September 7, 2006. Available at: https://www.wrapair.org/forums/dejf/fdh/content/FDHandbook_Rev_06.pdf. Last accessed on January 19, 2021.
Attachment:	No

RESPONSE TO IAAC-124

ID:	**IAAC-124**
Expert Department or Group:	CCN-08 CCN-28 SDFN-08 SDFN-32
Guideline Reference	6.3.4 Indigenous peoples 6.4 Mitigation measures 8.0 Follow-up and Monitoring Programs
EIS Reference	2.8.1.1 Air Contaminants 6.4.1.3 Mitigation 6.10 Summary of Commitments
Information Request:	a. Evaluate the potential effects of the use of chemicals for dust suppression on the atmospheric environment and on other VCs (e.g., vegetation deposition). b. Evaluate the potential impacts of chemical dust suppressants to vegetation, lands, wildlife, water, and Indigenous peoples. Identify potential avoidance behaviours of land users that may result from perceived contamination/effects and impact an Indigenous Nation’s ability to exercise its rights (i.e., resource harvesters who would otherwise use the area in absence of chemical dust suppressant). c. Provide mitigation measures for utilizing dust suppression chemicals and mitigating potential environmental effects.
Response:	a. Chemical dust suppressants will be applied to haul roads and access roads under limited conditions, as an alternative option to watering. Chemical dust suppressants will only be used as an adaptive management approach and application will be limited to periods during high wind conditions or if measured ambient PM concentrations are in exceedance of the Manitoba Ambient Air Quality Criteria and if an increase of watering is determined ineffective or unfeasible. The application of chemical dust suppressants will be limited to only inside the Project Development Areas (PDAs) where public access is restricted. The US EPA Expert Panel (the “Panel”) on potential environmental impacts of dust suppressants has summarized (US EPA 2002) the current state of knowledge on the potential environmental effects of chemical dust suppressants and the current regulations and guidelines for the use of chemical dust suppressants. The Panel has also provided recommendations for the development of a more comprehensive regulatory program for dust suppressant products and their use. The Panel’s summary report (US EPA 2002) states that: “*the expert panel was not able to identify specific concerns on the use of dust suppressants due to the high amount of variability associated with site conditions, dust suppressant composition, and application techniques. The experts did agree more attention should be paid to dust suppressant composition and management.*” The potential environmental effects of chemical dust suppressants will depend on their composition, application rates and interactions with other environmental components. The potential environmental effects include: • Surface and groundwater quality deterioration. • Soil contamination. • Toxicity to soil and fish. • Toxicity to humans during and after application.

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- Air pollution from volatile dust suppressant compounds and dust suppressant compounds attached to airborne dust particles.
- Impacts on native flora and fauna populations.

Salts and brines are the most common type of dust suppressants. Calcium chloride ($CaCl_2$) and magnesium chloride ($MgCl_2$) are the major products in this category. The primary known effects of salts in the environment relate to their capacity to move easily with water through soils. Water quality impacts include possible elevated chloride concentrations in streams downstream of application areas and shallow groundwater contamination. In the area near the application of salts, there could be negative impacts to plant growth. High levels of chloride in water bodies has been found to be toxic to fish (US EPA 2002).

Organic non-petroleum products include lignosulfonate, pine oil, vegetable derivatives and molasses. The majority of research in this category has focused on the impacts of lignosulfonate. Lignosulfonate is derived from the sulfite pulping process in the paper industry. High levels of lignosulfonate in water bodies have been shown to reduce biological activity and retard growth in fish. The 48-hour LC_{50} concentration (concentration of lignosulfonates which would be lethal to 50% of the tested population of fish within 48 hours) for lignosulfonate was found to be 7,300 mg/L (US EPA 2002).

Organic petroleum products are derived from waste oils, solvents, asphalt emulsions and tars. The potential environmental impacts of organic petroleum products are the highest compared to other chemical dust suppressants. The chemical characteristics of the oil results in varied impacts with the potential for high levels of heavy metals or other known toxic and carcinogenic compounds (US EPA 2002).

To reduce potential environmental effects associated with the use of chemical dust suppressants on the atmospheric environment and on other VCs (including vegetation and wetlands, groundwater, surface water and wildlife), only chemicals approved for use by Manitoba Transportation (2019) will be used and their application will comply with Manitoba Transportation (2019) regulatory requirements and follow best management practices (BMPs) for use of chemical dust suppressants.

Manitoba Transportation (2019; now Manitoba Infrastructure) has published a list of approved chemical products for the application of dust control. Manitoba Infraststructure's specification document (Specification No. 1280) regulates the approval, supply, and application of chemicals used for dust control and stabilization on gravel roads. The approved chemicals include liquid and flake products of calcium and magnesium chloride ($Ca/MgCl_2$) and liquid lignosulfonate. The use of petroleum or petroleum by-products as dust suppressants is not allowed. Specification No. 1280 provides a list of the approved chemical products, approved manufacturers/suppliers and the product rate of application. The specification document also describes the process for an approval of new chemical products that are not on the pre-approved list. The use and application of chemical dust suppressants for the Project will comply with Manitoba Infrastructure's regulatory requirements (Specification No. 1280).

Mitigation measures are described in further detail in part c of this response. With the application of these mitigation measures, compliance with provincial specifications and considering that the use of chemical dust suppressants will be limited to the PDA, and only used under limited conditions as an alternative to

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	watering, the use of chemical dust suppressants is not anticipated to result in significant effects to any VCs. b. The application of chemical dust suppressants will be limited to within the PDAs where public access is restricted, including for the harvesting of country foods, use for traditional purposes. Therefore, the lands and resources that Indigenous Nations and land users have access to will not be affected. As described in part a. of this response, potential environmental effects of chemical dust suppressants on vegetation and wetlands, groundwater, surface water and wildlife will be mitigated by using only chemicals approved for use by Manitoba Infrastructure (Manitoba Trasportation 2019) and applying them according to applicable regulatory requirements and following BMPs for use of chemical dust suppressants. Effects to vegetation and wetlands, groundwater, surface water, and wildlife, as well as the current use of land and resources for traditional purposes are predicted to be not significant. c. Mitigation measures to reduce the potential environmental effects of chemical dust suppressants that will be incorporated in the design of the equipment applying the dust suppressant (Manitoba Transportation 2019) include: • The equipment applying the chemical dust suppressant shall be propelled by a power unit capable of accurately maintaining a constant speed. • A pump capable of developing a constant uniform pressure in the spray bar. • Spray bar nozzles, which shall ensure uniform fan shaped spray without atomization, shall all be of the same manufacturers and size. Nozzles shall be set in the spray bar at angles which will allow each spray pattern to overlap the other in such a manner that should there be a malfunction of one nozzle, the nozzle on either side would substantially spray the area which would otherwise be missed. However, nozzles shall be cleaned immediately. • A strainer installed in the feed system to prevent clogging of the spray bar and nozzles. • A device or method that allows the operator to determine the volume remaining in the tank to an accuracy of 500 litres. • A meter system that allows the operator to determine the rate of application with accuracy while spreading the dust suppressant. The following BMPs will be applied to reduce the potential environmental effects of chemical dust suppressants used for the Project: • At 50 m from a water crossing, the equipment applying the dust suppressant will pass on the middle of the two lanes to prevent dust suppressant from entering surface water. • Dust suppressants will be applied when the wind speed does not exceed 15 to 20 km/h (4 to 5 m/s) to avoid ponding, runoff, drifting and tracking of material beyond the area of application. • Carefully monitor the application rate of dust suppressants to ensure adequate coverage without pooling or runoff of products. • The amount of dust suppressant applied should not exceed the minimum amount required to effectively suppress dust.

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	• To prevent loss of dust suppressant from the intended area of application, dust suppressants should not be applied during rain when the surface is in saturated condition or on areas of ponded water or roads that are subject to flooding. **Reference:** Manitoba Transportation. 2019. Specifications for the approval, supply, and application of dust control. Specification No. 1280. January 2019. United States Environmental Protection Agency (US EPA). 2002. Potential Environmental Impacts of Dust Suppressants: Avoiding Another Times Beach. An Expert Panel Summary. Las Vegas, Nevada. May 30-31, 2002. EPA/600/R-04/031. March 2004.
Attachment:	No

RESPONSE TO IAAC-125

ID:	**IAAC-125**
Expert Department or Group:	ECCC-05 MCCN-18 MCCN-89
Guideline Reference	6.2.1 Changes to the atmospheric environment 6.4 Mitigation measures 6.5 Significance of residual effects 8.0 Follow-up and Monitoring Programs
EIS Reference	6.4.1.3 Mitigation 6.7.1 Significance of Project Residual Effects 18.7.1 Significance of Project Residual Effects Volume 5, Appendix A Air Quality Baseline Technical Data Report 6.0 Environmental Control and Management Procedures
Information Request:	a. Describe how the significance determination of the effects assessment has considered the regulatory guideline exceedances for TSP, PM_{10}, and $PM_{2.5}$. b. Confirm that the Air Quality Management Plan will include: i. Monitoring methods to enable comparison with appropriate air quality objectives or standards that require 24-hour averaging periods, to verify the effectiveness of mitigation measures. ii. Describe proposed location(s) for ongoing air quality monitoring within the Air Quality Management Plan. iii. Describe mitigation measures that will be applied to reduce maximum concentrations of TSP, PM_{10}, and $PM_{2.5}$. Describe when these mitigation measures would apply.
Response:	a. As defined in Volume 1, Chapter 6 of the Environmental Impact Statement (EIS), a significant effect on air quality is one that results in predicted values that are greater than the applicable ambient air quality criteria (AAQC) (e.g., high in magnitude) and are of concern relative to one or more of: geographic extent, frequency of occurrence, and the presence of potentially sensitive receptors (e.g., human, wildlife, vegetation, soils or waterbodies). Predicted concentrations that are greater than the applicable AAQC, in themselves, do not imply that the effect on ambient air quality is significant. Dispersion models often produce results that are conservative (i.e., they overpredict concentrations). There is uncertainty associated with estimating fugitive PM emission rates using emission estimation algorithms developed by the United States Environmental Protection Agency (US EPA). Particularly, fugitive road dust emissions estimated with the US EPA emission factors have been found to substantially overpredict PM emissions, typically by a factor of 2 to 6 (Pace 2005; Countess 2007; Pouliot et al. 2010). This overprediction results in overprediction of the associated ambient TSP, PM_{10} and $PM_{2.5}$ concentrations and dust fall deposition. Therefore, the PM concentration and deposition predictions should be interpreted with a bias to overprediction in mind. The maximum predicted 24-hour and annual $PM_{2.5}$ concentrations along and outside the Project Boundary are less than the respective Canadian Ambient Air Quality Standards (CAAQS) during construction and operation, for both Gordon and MacLellan sites. The maximum predicted 24-hour PM_{10} and TSP concentrations are greater than the respective AAQC due primarily to fugitive dust emissions. Although the predicted PM_{10} and TSP concentrations are greater than

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the AAQC, an ambient air monitoring program will be implemented to monitor $PM_{2.5}$, PM_{10} and TSP ambient concentrations and to evaluate the need for additional mitigation measures to reduce fugitive dust emissions during construction and operation. With these considerations, and with mitigation measures and environmental protection measures as described in Volume 1, Chapter 6, Section 6.4.1.3 of the EIS, the residual environmental effects on air quality at the Gordon and MacLellan sites are predicted to be not significant.

b. In relation to the Air Quality Management Plan:

   i. Continuous meteorological monitoring and continuous ambient air monitoring of ambient TSP, PM_{10} and $PM_{2.5}$ concentrations will be implemented during Project construction and operation in conjunction with emissions mitigation to assess the effectiveness of the dust mitigation and to evaluate the need for more rigorous dust mitigation. Monitoring stations will be installed to measure both, background ambient particulate matter (PM) concentrations (in an upwind location from the Project sites) and ambient particulate matter concentrations influenced by the Project (in downwind locations).

   Continuous meteorological monitoring stations (each with a 10 m tower) will be installed at Gordon and MacLellan sites and will provide real time meteorological data to assist in the implementation of adaptive management for dust emissions. The meteorology parameters that will be measured are expected to include:

   - Wind speed and wind direction.
   - Ambient air temperature.
   - Relative humidity.
   - Atmospheric pressure.
   - Rainfall and snowfall.

   Meteorological monitoring data will be saved in a data logger and downloaded automatically on an hourly basis. Automatic alerts will be set to notify environmental representatives of high winds (wind speed greater than 5 m/s) and dry conditions (less than 2 mm of precipitation has occurred in the previous 24 hours and the temperature is greater than 15°C), which will trigger the implementation of additional dust mitigation measures.

   Continuous ambient air monitoring of TSP, PM_{10} and $PM_{2.5}$ concentrations is proposed at four monitoring locations (see response to b. ii) using GRIMM Environmental Dust Monitor (EDM) 180 (or equivalent). The GRIMM EDM 180 analyzer uses light-scattering technology with semiconductor-laser as the light-source to measure particulate concentrations in ambient air. The GRIMM EDM 180 analyzer can measure simultaneously PM of different particulate sizes, including TSP, PM_{10} and $PM_{2.5}$. However, one of the siting restrictions for the GRIMM analyzer is that it requires continuous AC power. Power for the MacLellan site will be provided by Manitoba Hydro grid and power to Gordon site will be provided by two stationary diesel 300 kW generators (one continuous and one stand-by) during Project operation only. Therefore, a different particulate matter monitor is proposed at Gordon site during construction - Met One portable Beta Attenuation Monitor (E-BAM) (or equivalent), because this monitor can operate with an alternative source of power, such as solar panels and batteries.

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	The Met One E-BAM continuous analyzer uses beta radiation attenuation to measure particulate concentrations in ambient air. E-BAM monitors are set to a fixed particulate size fraction of interest, typically 10 µm (PM_{10}) or 2.5 µm ($PM_{2.5}$), by attaching a size-selective inlet to the analyzer. Therefore, three co-located Met One E-BAM monitors measuring TSP, PM_{10} and $PM_{2.5}$ will be installed at Gordon site during construction. Power for the monitors will be provided by an array of solar panels and a small wind turbine, which will charge a bank of deep-cycle marine batteries. The Met One E-BAMs will operate during summer when there is sufficient solar energy available to power the systems. These monitors will be replaced by a GRIMM EDM 180 monitor during operation when continuous AC power is available at the Gordon site. An automated software system will be used to download 1-hour and 24-hour rolling average TSP, PM_{10} and $PM_{2.5}$ concentrations from the GRIMM EDM 180 continuous ambient air monitors on an hourly basis. The measured 24-hour average ambient TSP, PM_{10} and $PM_{2.5}$ concentrations will be compared to the Manitoba AAQC. If the ambient TSP, PM_{10} or $PM_{2.5}$ concentrations are greater than the 24-hour average Manitoba AAQC, additional mitigation measures to reduce PM emissions will be implemented as described in Volume 1, Chapter 6, Section 6.4.1.3 of the EIS, for example, additional watering or application of chemical dust suppressants (see response b. iii). ii. The proposed locations for ambient air quality monitoring stations, including TSP, PM_{10} and $PM_{2.5}$, are based on areas with predicted elevated PM concentrations, predominant wind directions to determine monitoring locations upwind and downwind of the Project activities, and proximity to sensitive receptors, such as the communitites of Lynn Lake and Marcel Colomb First Nation. A wind rose and a histogram of wind speed frequency distribution from Lynn Lake Airport (2015-2018) is presented in Figure IAAC-125-1. The wind rose illustrates that the predominant winds are from northwest. Easterly and southerly winds also dominant. Southwesterly and northeasterly winds are less frequent and generally less frequently strong. The proposed ambient air quality monitoring locations are described below and summarized in Table IAAC-125-1. The approximate locations of the stations are shown on Map IAAC-125-1. The final locations will be confirmed during the permitting stage based on regulatory siting criteria, accessibility to the monitoring sites and access to continuous AC power. • Station A (Upwind/Downwind) – site located at Burge Lake Provincial Park, approximately 4.9 km west of MacLellan site and in a predominantly upwind location from MacLellan site. The monitoring station will be used to determine background ambient PM concentrations. The site could be downwind of the MacLellan site during easterly and southeasterly winds. The monitoring station will record ambient air quality in the park and sensitive receptors west of the park during easterly and southeasterly winds. • Station B (Community) - monitoring station in the residential area of Lynn Lake, approximately 6.2 km south of MacLellan site. The proposed location coincides with the baseline dustfall monitoring station in Lynn Lake (EIS, Volume 4, Appendix A). • Station C (Downwind) – monitoring station at the permanent work camp at MacLellan site. An automated meteorological monitoring station is also

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proposed to be installed at this location. Continuous PM monitoring data will be used for adaptive management of dust emissions at the MacLellan site.

- Station D (Downwind) – monitoring station at the Gordon site entry gate. The exact location of the monitoring station will be determined based on access to continuous AC power during operation. An automated meteorological monitoring station is also proposed to be installed at this location. Continuous PM monitoring data from this station will be used for adaptive management of dust emissions at the Gordon site. This station will record the ambient air quality conditions that are representative of sensitive receptors in the vicinity of Gordon site.

iii. Volume 1, Chapter 6 of the EIS describes the dust mitigation measures that will be implemented to manage and reduce fugitive dust emissions during Project construction and operation. No new mitigation measures have been identified that were not included in the EIS.

Mitigation measures that are incorporated in the Project design and documented in the EIS include:

- Enclosure of the mill feed storage area and crushing plant conveyors and the fine ore stockpile to reduce fugitive dust emissions.
- Use of dust collection/control systems (e.g., baghouse) at the primary crusher and the processing plant gold room to reduce PM emissions. Use of a wet scrubber at the secondary crusher.
- Optimization of haul roads and infrastructure to reduce transportation and haul distances.
- Optimization of the TMF to reduce the area of exposed dry surfaces to reduce the potential for windblown dust emissions.

The following Best Management Practices (BMPs) will be implemented to manage and reduce fugitive dust emissions during construction and operation:

- On-site haul roads and access roads will be maintained in good condition.
- During dry periods, water will be applied to haul roads and access roads. Watering will be repeated several times a day depending on surface and meteorological conditions, to maintain a 75% dust control efficiency.
- Chemical dust suppressants will be applied to haul roads on a limited basis, as an alternative option to watering. Chemical dust suppression will only be applied on an as-needed basis during high wind conditions or if measured ambient PM concentrations are in exceedance of the Manitoba AAQC and if an increase of watering is determined ineffective or unfeasible at the time.
- Speed limits on the haul roads and access roads
- Track-out of material to PR 391 will be reduced by dust sweeping and truck wheel washing stations prior to entering onto PR 391.
- Surfaces of topsoil and overburden stockpiles will be stabilized during extended periods between usage, by means of vegetating or covering the exposed surfaces.

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	• If the ambient air quality monitoring program indicates that the ambient TSP, PM$_{10}$ or PM$_{2.5}$ concentrations are greater than Manitoba AAQC, additional mitigations to reduce dust emissions will be implemented. The additional dust mitigation measures could include: ▪ Increased watering frequency on haul roads and access roads. ▪ Application of chemical dust suppressants on haul roads and access roads. ▪ Temporary suspension of construction and mining activities during high wind conditions. **References:** Countess, R., 2007. Reconciling Fugitive Dust Emission Inventories with Ambient Measurements. Countess Environmental, 4001 Whitesail Circle, Westlake Village, CA 91361 12th International Emission Inventory Conference - "Emission Inventories - Applying New Technologies". San Diego, April 29 - May 1, 2003. Pace, T.G. 2005. Methodology to Estimate the Transportable Fraction (TF) of Fugitive Dust Emissions for Regional and Urban Scale Air Quality Analyses. US EPA, Research Triangle Park NC, August 2005. Available at: https://www.nrc.gov/docs/ML1321/ML13213A386.pdf. Last accessed on February 8, 2021. Pouliot, G., H. Simon, P. Bhave, D. Tong, D. Mobley, T. Pace and T. Pierce. 2010. Assessing the Anthropogenic Fugitive Dust Emission Inventory and Temporal Allocation using an Updated Speciation of Particulate Matter. 19th Annual International Emission Inventory Conference "Emissions Inventories - Information Emerging Issues". San Antonio, Texas, September 27-30, 2010. Available at: https://www3.epa.gov/ttnchie1/conference/ei19/session9/pouliot.pdf. Last accessed on February 8, 2021.
Attachment:	Appendix A, Attachment IAAC-125

RESPONSE TO IAAC-126

ID:	**IAAC-126**
Expert Department or Group:	ECCC-06 HC-02 MCCN-89
Guideline Reference	6.1.1 Atmospheric Environment 6.2.1 Changes to the atmospheric environment 6.4 Mitigation measures 6.5 Significance of residual effects 8.0 Follow-up and Monitoring Programs
EIS Reference	6.7.1.1 Changes in Air Quality Tables 6-10, 6-21 and 6-22 18.7.1 Significance of Project Residual Effects Volume 5, Appendix A Lynn Lake Gold Project, "Air Quality Impact Assessment Technical Modelling Report" 8.0 Dispersion Model Results Appendix G Map G- 5 Appendix H Lynn Lake Gold Project, Human Health and Ecological Risk Assessment Technical Modelling Report 5.3.3 Inhalation Ambient Air Quality Criteria (CAC) 5.4.3 Human Health Risk via Inhalation 5.4.7 Summary
Information Request:	a. Evaluate options for monitoring, management, and technically and economically feasible mitigation measures for the Project's predicted NO_2 emissions. i. Indicate which options the proponent commits to and provide supporting rationale. ii. Confirm that the Air Quality Management Plan will include NO_2 monitoring to enable comparison with appropriate standards (e.g., 1-hour CAAQS) and will incorporate mitigation measures to reduce potential NO_2 exceedances of 1-hour NO_2 CAAQS. b. Identify technically and economically feasible mitigation measures for reducing potential health effects associated with NO_2 exposure.
Response:	a. i. In relation to the mitigation measures to reduce NO_2 emissions: Diesel combustion exhaust from construction and mining equipment such as drills, excavators, bulldozers and haul trucks, is the major source of NO_x emissions during Project construction and operation. The mitigation measures that will be implemented to manage and reduce diesel exhaust emissions from off-road equipment and vehicles, including NO_x, during Project construction, operation and decommissioning are described in Chapter 6 of the EIS and listed in response b. No new mitigation measures have been identified that have not been included in the EIS. ii. In relation to ambient air quality monitoring of NO_2: Ambient air quality monitoring of NO_2 during Project construction, operation and decommissioning is not proposed for two reasons: 1) Determination of achievement of the NO_2 Canadian Ambient Air Quality Standards (CAAQS) is based on the measured air quality concentrations at community monitoring stations and not near the property line of an industrial

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facility (CCME 2020). The CCME's Guidance Document on achievement determination for CAAQS for NO_2 (2020) states that:

"Stations located at or near the property (fence) line of an industrial facility should not be used for NO_2 CAAQS reporting unless the station is near a populated area or a sensitive ecosystem. Under NAPS (National Air Pollution Surveillance), a fence-line monitoring station is defined as: a station that is located within or on the property line of a facility or a station that is very near to a facility and in areas not used or accessed by the public or with no nearby population of appreciable size."

Possible locations for a community monitoring station for determining achievent of the NO_2 CAAQS include Lynn Lake or Black Sturgeon Reserve; however, the predicted 98th percentile of daily-maximum 1-hour average NO_2 concentrations and annual average NO_2 concentrations at Lynn Lake and Black Sturgeon Reserve during Project operation are less than the respective CAAQS. Therefore, ambient air quality monitoring of NO_2 concentrations in Lynn Lake and Black Sturgeon Reserve to enable comparison with the CAAQS is not warranted.

2) The human health risk assessment (EIS Chapter 18) has determined negligible human health risk for inhalation exposure to NO_2 for people in the air quality local assessment area (LAA), including Potential Indigenous Receptors, and for off-duty workers in the worker camp.

Although the air quality assessment (Volume 1, Chapter 6 of the EIS) has predicted exceedances of the 2025 1-hour NO_2 CAAQS (79 $\mu g/m^3$) at three special receptor locations near the Gordon site and at five special receptor locations near the MacLellan site, the predicted exceedances that sustain over three or more consecutive hours occured during the winter months (November through May) and between 19:00 and 6:00, a time period when people would be unlikely to be present at the locations where the exceedances are predicted to occur. Furthermore, the Traditional Land and Resources Use studies (Volume 2, Chapter 17 of the EIS) do not identify habitations in the vicinity of the special receptor locations where exceedances of the 2025 1-hour NO_2 CAAQS are predicted to occur.

Based on the results of the human health risk assessment (Volume 2, Chapter 18 of the EIS), it is reasonable to conclude that inhalation exposure to NO_2 represents a negligible human health risk for people who may be in the LAA and for off-duty workers at the work camp.

Therefore, ambient air quality monitoring of NO_2 is not proposed during Project construction, operation and decommissioning. NO_x emissions and associated ambient NO_2 concentrations from off-road equipment and vehicles diesel exhaust will be managed and reduced by implementing the mitigation measures described in response b.

b. The mitigation measures that will be implemented to manage and reduce diesel exhaust emissions from off-road equipment and vehicles during Project construction, operation and decommisioning are described in Volume 1, Chapter 6 of the EIS.

Mitigation measures to reduce diesel exhaust emissions (including NO_2) from off-road equipment and vehicles that are incorporated in the Project design include:

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	• Mining off-road equipment used during Project operation will comply with the most stringent (Tier 4) emission standards (i.e., newer equipment manufactured during or after 2014) for off-road diesel engines (ECCC 2005). • Construction off-road equipment will comply with the most stringent (Tier 4) emission standards for off-road diesel engines (ECCC 2005) to the extent possible and where feasible. The construction fleet will be rented and might include older equipment. Project emissions during construction were conservatively estimated based on Tier 3 emission standards (i.e., older equipment). Mitigation measures based on BMPs will be implemented to manage and reduce diesel exhaust emissions from off-road equipment and vehicles, including NOx and associated ambient NO_2 concentrations. The following BMPs will be implemented for the management and reduction of diesel exhaust emissions during construction, operation and decommissioning: • Engines and exhaust systems will be properly maintained to keep construction and mining equipment in good working condition. • Haul trucks and vehicle idling times will be reduced to the extent possible. • Cold starts will be limited to the extent possible. **Reference:** CCME. 2020. Guidance Document on Achievement Determination for Canadian Ambient Air Quality Standards for Nitrogen Dioxide. Canadian Council of Ministers of the Environment (CCME). 2020. ECCC. 2005. Off-Road Compression-Ignition Engine Emission Regulations. SOR/2005-32. Available at: https://laws-lois.justice.gc.ca/PDF/SOR-2005-32.pdf. Last accessed on January 25, 2021.
Attachment:	No

RESPONSE TO IAAC-127

ID:	**IAAC-127**
Expert Department or Group:	CCN-131 MCCN-102 MCCN-103 SDFN-152
Guideline Reference	8.0 Follow-up and Monitoring Programs
EIS Reference	23.5.7 Air Quality Management Plan 23.5.9 Greenhouse Gas Management Plan
Information Request:	a. Describe the follow-up and monitoring programs, including the Air Quality Management Plan (consider responses to IAAC-125 and IAAC-126), and the Greenhouse Gas Management Plan, for the atmospheric environment. i. Include the parameters to be measured, the planned implementation timetable for follow-up studies, monitoring methods, reporting mechanisms, regulatory instruments used, characterization of monitoring activities, production of monitoring reports, and sharing of information. ii. Provide details for the Air Quality Management Plan. iii. Provide details for the Greenhouse Gas Management Plan. iv. Identify how Indigenous Nations were and will be involved in the development, implementation, monitoring, and follow-up activities for the atmospheric environment.
Response:	a. As described in Volume 1, Chapter 6 of the EIS for the assessment of potential effects on the atmospheric environment (Section 6.9 Follow-up and Monitoring) and in the Air Quality Technical Modelling Report (Volume 5, Appendix A, Section 6.3 Air Quality Monitoring and Adaptive Management), an ambient air monitoring program will be implemented to monitor ambient $PM_{2.5}$, PM_{10} and TSP concentrations during Project construction and operation. The results of the ambient PM monitoring will be used to assess the effectiveness of the dust mitigation and to evaluate the need for more rigorous dust mitigation. A greenhouse gas (GHG) management and monitoring plan will detail technically and economically feasible mitigation measures to manage and reduce GHG emissions throughout the life of the Project. The GHG mitigation measures were presented in the EIS in Volume 1, Chapter 6 for the assessment of potential effects on the atmospheric environment (Section 6.4.2.3 Mitigation) and in the Air Quality Technical Modelling Report (Volume 5, Appendix A, Secton 6 Environmental Control and Management Procedures). No new GHG mitigation measures have been identified that were not included in the EIS. Adaptive management and the criteria for implementation will also be discussed in the GHGMMP. i. The Air Quality and GHG Management and Monitoring Plans (AQMMP and GHGMMP, respectively) will provide details about the proposed ambient air quality monitoring program and the mitigation and adaptive management measures that will be implemented to manage and reduce emissions of air contaminants and GHG emissions during all phases of the Project. An ambient air monitoring program will be implemented to monitor ambient $PM_{2.5}$, PM_{10} and TSP concentrations during Project construction and operation. Details about the AQMMP are provided in response a. ii. Details about the GHGMMP are provided in response a. iii.

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Management and monitoring plans will describe (as applicable) the location of interventions, planned protocols, lists of measured parameters, analytical methods employed, schedule, resources required as well as parameters to be monitored, methodology and equipment to be used, frequency, duration of monitoring, adaptive management triggers/thresholds, and reporting requirements. Finalization of management and monitoring plans will occur during the permitting stage of Project planning (i.e., following receipt of a federal Decision Statement for the Project under *CEAA 2012* and provincial licences for the Project under *The Environment Act* of Manitoba) and will be completed prior to the start of Project construction.

ii. The AQMMP will describe the proposed ambient air quality monitoring program and the mitigation measures that will be implemented to manage and reduce emissions during Project construction and operation.

Continuous meteorological monitoring (wind speed and wind direction) and continuous ambient air monitoring of ambient TSP, PM$_{10}$ and PM$_{2.5}$ concentrations will be implemented during Project construction and operation in conjunction with emissions mitigation to assess the effectiveness of the dust mitigation and to evaluate the need for more rigorous dust mitigation. Monitoring stations will be installed to measure both, background ambient particulate matter (PM) concentrations (in an upwind location from the Project sites) and ambient particulate matter concentrations influenced by the Project (in downwind locations).

Meteorological monitoring stations (each with a 10 m tower) will be installed at Gordon and MacLellan sites and will provide continuous real time meteorological data to assist in the implementation of adaptive management for dust emissions. The meteorology parameters that will be measured are expected to include:

- Wind speed and wind direction.
- Ambient air temperature.
- Relative humidity.
- Atmospheric pressure.
- Rainfall and snowfall.

Meteorological monitoring data will be saved in a data logger and downloaded automatically on an hourly basis. Automatic alerts will be sent to notify environmental representatives of high winds (wind speed greater than 5 m/s) and dry conditions (less than 2 mm of precipitation has occurred in the previous 24 hours and the temperature is greater than 15°C), which will trigger the implementation of additional dust mitigation measures.

Continuous ambient air monitoring of TSP, PM$_{10}$ and PM$_{2.5}$ concentrations is proposed at four monitoring locations using GRIMM Environmental Dust Monitor (EDM) 180 (or equivalent). The GRIMM EDM 180 analyzer uses light-scattering technology with semiconductor-laser as the light-source to measure particulate concentrations in ambient air. The GRIMM EDM 180 analyzer can simultaneously measure PM of different sizes, including TSP, PM$_{10}$ and PM$_{2.5}$. However, one of the siting restrictions for the GRIMM analyzer is that it requires continuous AC power. Power for the MacLellan site will be provided by Manitoba Hydro grid and power to Gordon site will be provided by two

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	stationary diesel 300 kW generators (one continuous and one stand-by) during Project operation only. Therefore, a different particulate matter monitor is proposed at Gordon site during construction - Met One portable Environmental Beta Attenuation Monitor (E-BAM) (or equivalent), because this monitor can operate with an alternative source of power, such as solar panels and batteries. The Met One E-BAM-continuous analyzer uses beta radiation attenuation to measure particulate concentrations in ambient air. E-BAM-monitors are set to a fixed particulate size fraction of interest, typically 10 µm (PM_{10}) or 2.5 µm ($PM_{2.5}$), by attaching a size-selective inlet to the analyzer. Therefore, three co-located Met One E-BAM-monitors measuring TSP, PM_{10} and $PM_{2.5}$ will be installed at Gordon site during construction. Power for the monitors will be provided by an array of solar panels and a small wind turbine, which will charge a bank of deep-cycle marine batteries. The Met One E-BAMs will operate during summer when there is sufficient solar energy available to power the systems. These monitors will be replaced by a GRIMM EDM 180 monitor during operation when cotinuous AC power is available at the Gordon site. An automated software system will be used to download 1-hour and 24-hour rolling average TSP, PM_{10} and $PM_{2.5}$ concentrations from the GRIMM EDM 180 continuous ambient air monitors on an hourly basis. The measured 24-hour average ambient TSP, PM_{10} and $PM_{2.5}$ concentrations will be compared to the Manitoba AAQC. If the ambient TSP, PM_{10} or $PM_{2.5}$ concentrations are greater than the 24-hour average Manitoba AAQC, additional mitigation measures to reduce PM emissions will be implemented as described in Volume 1, Chapter 6, Section 6.4.1.3 of the EIS, for example, additional watering or application of chemical dust suppressants. The proposed locations for ambient air quality monitoring stations, including TSP, PM_{10} and $PM_{2.5}$, are based on areas with model predicted elevated PM concentrations, predominant wind directions to determine minitoring locations upwind and downwind of the Project activities, and proximity to sensitive receptors, such as the communitites of Lynn Lake and Marcel Colomb First Nation. A wind rose and a histogram of wind speed frequency distribution from Lynn Lake Airport (2015-2018) is presented in Figure IAAC-127-1. The wind rose illustrates that the predominant winds are from northwest. Easterly and southerly winds are also dominant. Southwesterly and northeasterly winds are less frequent and generally less frequently strong. The proposed ambient air quality monitoring locations are described below. The final locations will be confirmed during the permitting stage based on regulatory siting criteria, accessibility to the monitoring sites and access to continuous AC power. • Station A (Upwind/Downwind) – site located at Burge Lake Provincial Park, approximately 4.9 km west of MacLellan site and in a predominantly upwind location from MacLellan site. The monitoring station will be used to determine background ambient PM concentrations. The site could be downwind of the MacLellan site during easterly and southeasterly winds. The monitoring station will record ambient air quality in the park and sensitive receptors west of the park during easterly and southeasterly winds.

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- Station B (Community) - monitoring station in the residential area of Lynn Lake, approximately 6.2 km south of MacLellan site. The proposed location coincides with the baseline dustfall monitoring station in Lynn Lake (EIS, Volume 4, Appendix A).
- Station C (Downwind) – monitoring station at the permanent work camp at MacLellan site. An automated meteorological monitoring station is also proposed to be installed at this location. Continuous PM monitoring data will be used for adaptive management of dust emissions at the MacLellan site.
- Station D (Downwind) – monitoring station at the Gordon site entry gate. The exact location of the monitoring station will be determined based on access to continuous AC power during operation. An automated meteorological station is also proposed to be installed at this location. Continuous PM monitoring data from this station will be used for adaptive management of dust emissions at the Gordon site. This station will record the ambient air quality conditions that are representative of sensitive receptors in the vicinity of Gordon site.

Reports from the ambient air quality monitoring program will be submitted annually to Manitoba Conservation and Climate (MCC) and shared with interested Indigenous Nations and stakeholders. The annual reports will include the results of the ambient air monitoring program following a standardized format, including:

- A map showing the location of emitting sources, property boundary and ambient air quality monitoring stations.
- A summary of operations - parameters monitored, equipment model, frequency of site visits and calibrations, confirmation of data backups.
- A summary of audits and audit outcomes.
- Summary statistics of measured ambient air concentrations (e.g. annual arithmetic mean, maximum 24-hour, percent of valid data).
- A summary of exceedances of Manitoba ambient air quality criteria, number of times that exceedances occurred, the meteorology conditions that coincided with the exceedances, and additional mitigation meausures used during exceedance periods.

iii. A description of the GHG parameters to be measured, planned implementation timetable for follow-up studies, monitoring methods, reporting mechanisms, regulatory instruments used, characterization of monitoring activities, production of monitoring reports and sharing of information is provided below.

The regulatory instrument that defines the GHG monitoring program is the Government of Canada's Output-Based Pricing System (OBPS) under the federal Greenhouse Gas Pollution Pricing Act (the Act). As of 2019, the federal carbon pollution pricing system under the federal Act applies to Manitoba. The federal system prices carbon pollution at a rate of $50 per tonne by 2022 (Osler 2021) and increasing by $15 per tonne annually until it reaches $170 per tonne by 2030. Under the Act, the federal carbon pollution pricing system has two parts:

- A regulatory charge on fuel (federal fuel charge).

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- A regulatory trading system for large industry – the federal OBPS.

OBPS is a regulatory trading system for industry and applies to large industrial facilities that emit greater than 50,000 tonnes per year of CO_2e GHG emissions. Facilities emitting 10,000 tonnes per year of CO_2e GHG emissions or more in certain sectors can apply to participate voluntarily in OBPS. OBPS is designed to ensure there is a price incentive for industrial emitters to reduce their GHG emissions and encourage innovation while maintaining competitiveness and protecting against “carbon leakage” (i.e., the risk of industrial facilities moving from one region to another to avoid paying a price on carbon pollution). The OBPS Regulations contain the details about the minimum thresholds for industrial facilities to report their GHG emissions, monitoring methods and the reporting mechanisms.

iv. As part of the GHG monitoring, the Project would measure the following parameters in order to be in a position to report their annual GHG emissions to Environment and Climate Change Canada (ECCC) if those emissions are greater than the reporting threshold:

- On-site electricity production (this would apply to the Gordon site because it will rely on electricity produced by diesel generators, but it would not apply to the MacLellan site that will rely on grid power supplied by Manitoba Hydro).
- Mine production (tonnes of material mined per year and the throughput for the mineral processing plant at the MacLellan site).
- Fuel consumption for stationary combustion at the Gordon site.
- Fuel consumption for the transportation activities at Gordon and MacLellan sites.
- Wastewater production and treatment emissions.
- Incineration (waste emissions).
- Blasting emissions calculated from the blasting frequency and amount and type(s) of explosives used.

Only on-site transportation emissions for which an exemption certificate applies need to be reported. If a fuel is exempt from federal carbon tax then it is reported under the OBPS – this prevents double payment of GHG-related tax/compliance costs on these fossil fuels.

The other potential sources of GHG emissions that may need to be reported include:

- Industrial process emissions
- Industrial product use emissions (SF_6, NF_3, PFCs, HFCs)
- Venting emissions
- Flaring emissions
- Leakage emissions.

Some of these types of emissions are not applicable to LLGP (e.g., venting, flaring and leakage). These GHG and production monitoring activities can be broadly characterized as part of the accounting systems necessary to track fuel and energy consumption, industrial processes and waste production.

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These parameters to be measured are used to calculate GHG emissions from the Project (e.g., CO_2, CH_4 and N_2O) using ECCC emissions factors that have been deemed acceptable for OBPS reporting. Electrical generation and production of final product will also require direct measurement with appropriate quality assurance and control for OBPS reporting. Direct measurement of GHG emissions from the Project sources using continuous emissions monitoring systems (CEMS) is not required for OBPS reporting.

If the LLGP annual GHG emissions are greater than the OBPS reporting threshold (50,000 tonnes CO2e), emissions along with production are required to be reported to ECCC. Under the OBPS, industrial facilities pay on their emissions intensity that exceed a set level for the industry. Facilities that emit less than the level earn surplus credits they can bank or sell. The Government of Canada will return all direct proceeds from the federal OBPS system to the province or territory where they were collected. Provincial and terrotorial governments that have committed to addressing climate change by voluntarily adopting the federal OBPS system will receive their proceeds directly from the federal government and can decide on how to use them (ECCC 2019.).

The follow-up study program verifies the accuracy of the LLGP EIS and the effectiveness of the measures implemented to mitigate the adverse effects of the Project. The form and frequency of follow-up reporting will be determined as the Project progresses through the EIS and permitting processes. It is anticipated that those elements, relative to the GHGMMP, will be assembled into a formal summary report and provided to interested parties on an annual basis during construction and operation and during decommissioninig/closure when monitoring is carried out. The reporting will be used to inform adaptive management reviews. The reporting will also include documentation related to communication from external interested parties, including complaints. The follow up GHGMMP annual reports would be communicated to the external parties that expressed an interest in the GHGMMP using some type of formal communication (e.g., telephone call, email, text message, written response to a LLGP information brochure). The information sharing activities related to the GHGMMP would be tracked using an electronic tracking system such as the StakeTracker® stakeholder information management software.

The adaptive management program for LLGP was described in the EIS in Volume 3, Chapter 23, Section 23.2 of the EIS. The GHGMMP will be re-evaluated annually to verify implementation, and the continued suitability, adequacy and effectiveness of the Plan. The review will identify elements of the GHGMMP in need of revision and evaluate performance against established performance objectives. The objectives of the annual review are to:

- Maintain compliance with regulatory requirements.
- Identify opportunities for improvement such as review of newly advanced technologies to improve GHG performance or implementation of new operational policies and procedures to reduce emissions.
- Incorporate community considerations.

The review will include:

- Legislation, approvals, environmental compliance approval changes.

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	- Review the recent technological advancements relevant to the reduction of GHG emissions from a open pit mine in a remote location and determine the feasibility for implementation considering the technical, economic and community aspects. - Community complaints, enquiries and corrective actions. - Community and regulatory liaison and feedback. The annual review of the GHGMMP will discuss the potential application of commercially proven technologies (e.g., renewable energy sources, cleaner energy sources, power grid optimization, electrification of operations, transportation and facilities, distributed power generation and networks, and low-emission fuels) to reduce GHG emissions. The feasibility of the use of potential new technologies to reduce GHG emissions will consider the increasing price of carbon, the operational procedures required to apply the new technology, and the associated capital and operating expenditures. These considerations will be evaluated in the context of the Project's 13 year operational mine life, its remote northern location, and electrical grid supply constraints. In accordance with the ECCC's Strategic Assessment of Climate Change, the GHGMMP will progressively be developed as the Project moves through the EIS, permitting and construction, and updated based on continual improvement during operations through adaptive management. v. As described in Volume 3, Chapter 23 of the EIS, Alamos will engage with Indigenous Nations regarding the design and implementation of Project follow-up and monitoring programs, including evaluation of program results, and subsequent updates to the program. Alamos will discuss planned monitoring activities with directly-affected Indigenous Nations and provide opportunities for Indigenous Nations to participate in these follow-up and monitoring programs. In the past, for example, five Elders of Marcel Colomb First Nation formed a co-committee with Alamos for environmental monitoring of activities associated with the exploration program deemed to be of high impact (i.e., scout drilling and excavation trenching). In 2020, Marcel Colomb First Nation selected youth representatives to participate in the environmental monitoring activities. This committee or a similar committee could be engaged for follow up and monitoring of the Project. Information on conceptual monitoring and management plans was provided to Indigenous Nations on April 21 (registered mail) and April 22 (email), 2021. Alamos has not received any comments from Indigenous Nations regarding this material to date. As described in Volume 3, Chapter 23, Section 23.3 of the EIS, as results become available from the follow-up and monitoring program, they will be shared with Indigenous Nations, in a fashion, frequency, and format determined to be appropriate to the applicable audience. A communication mechanism for providing data will be established to distribute information and accept inquiries from Indigenous Nations. Alamos currently maintains a local office/presence in Lynn Lake that facilitates ongoing communications. During operation, Alamos will maintain an office at the MacLellan site and will consider maintaining a smaller office in Lynn Lake during Project operation to further facilitate communication.

ID:	**IAAC-127**
	References: ECCC. 2019. Use of Proceeds from the Federal Output-Based Pricing System, seeking input on the approach for returning proceeds to support climate action. Available at: https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/output-based-pricing-system/use-of-proceeds.html. Accessed: April 2021. Osler, Hoskin & Harcourt LLP (Osler). 2021. April 2021 Carbon and Greenhouse Gas Legislation in Manitoba. Available at: https://www.osler.com/PDFs/Resource/en-ca/Carbon-and-Greenhouse-Gas-Legislation-in-Manitoba.pdf. Accessed: April 2021.
Attachment:	Appendix A, Attachment IAAC-127

RESPONSE TO IAAC-128

ID:	**IAAC-128**
Expert Department or Group:	ECCC-08 IAAC
Guideline Reference	1.4 Regulatory framework and the role of government 6.1.1 Atmospheric Environment 6.2.1 Changes to the atmospheric environment 6.4 Mitigation measures
EIS Reference	EIS Summary 6.1.1.2 Greenhouse Gases 6.4.1.3 Mitigation 6.4.2 GHG Emissions Volume 5, Appendix A Lynn Lake Gold Project, Air Quality Impact Assessment Technical Modelling Report 10.0 Summary and Conclusions
Information Request:	a. Describe the technically and economically feasible mitigation measures considered for all phases (including decommissioning and closure) of the Project for all GHG emission sources attributed to the Project, including any technological innovations, BAT, and BMPs. i. Describe the mitigation measures in the context of regional, provincial and/or national objectives, standards or guidelines pertaining to current provincial/territorial/federal limits for GHG emission targets. ii. Describe what mitigation measures will be implemented and when. Provide the criteria/rationale (such as feasibility) that was used in determining which mitigation measures were appropriate. b. Considering the response to IAAC-127, describe the monitoring and follow-up that will be conducted under the Greenhouse Gas Management Plan, including how effectiveness of mitigation measures will be determined. Describe any proposed adaptive management and criteria for implementation.
Response:	a. The technically and economically feasible greenhouse gas (GHG) mitigation measures are discussed in Volume 1, Chapter 6, Sections 6.4.1.3 and 6.4.2.3 of the Environmental Impact Statement (EIS) and included: optimization of haul roads and infrastructure to reduce transportation and haul distances, proper maintenance for the engines and exhaust systems associated with the mobile equipment used for construction, operation and decommissioning, limiting idling times and cold starts to the extent possible. No new GHG mitigation measures have been identified that have not been included in the EIS. i. The technically and economically feasible GHG mitigation measures cannot be fully evaluated at this time in the context of the current provincial/territorial/ federal limits for GHG emission targets. The reduction in GHG emissions for the mitigation measures that are described above (and below) are generally well understood and have been considered in the EIS, however, the GHG reductions made possible by new technology innovations are not well understood at this time because the technology innovations are a work in progress and may not be proven effective in the marketplace and may not be technically or economically feasible at this time. What is known at this time is that the Project GHG emissions make a minor contribution to the provincial/territorial/federal GHG emissions targets. Canada's international

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commitment is to reduce GHG emissions by 30% below 2005 levels by 2030. The 2005 baseline level is 730 Mt CO$_2$e and the target it to reduce to 511 Mt CO$_2$e by 2030. The estimated peak annual GHG emissions for the Project are 0.068 Mt CO$_2$e (68,028 t CO$_2$e) for Year 7 of operation. The peak annual GHG emissions for the Project are 0.013% of Canada’s GHG emissions target for 2030 (511 Mt CO$_2$e).

Manitoba’s total GHG emissions in 2017 were 21.7 Mt CO$_2$e. The estimated peak annual GHG emissions for the Project are 0.068 Mt CO$_2$e (68,028 t CO$_2$e) for Year 7 of operation. The peak annual GHG emissions for the Project are 0.3% of Manitoba’s GHG emissions for 2017 (21.7 Mt CO$_2$e).

ii. The mitigation for GHG emissions through optimization of haul roads and infrastructure to reduce transportation and haul distances will be implemented before construction. This type of mine planning is typically done during the pre-feasibility and feasibility design stages that occur before the environmental assessment and the licensing and permitting phases. This mitigation measure is widely used in the mining industry because it has many benefits. Besides a reduction in GHG emissions this mitigation measure will result in a reduction in operating and capital costs because it results in lower overall fuel consumption and a smaller mine fleet. The remaining GHG mitigation measures as described in Volume 1, Chapter 6, Section 6.4.2.3 of the EIS are applicable to all mine phases (construction, operation and decommissioning) and have been proven effective (feasible) throughout the industry as best management practices (i.e., proper maintenance for the engines and exhaust systems associated with the mobile equipment, limiting idling times and cold starts to the extent possible).

b. GHG emissions will be managed throughout the life of the Project based on the GHG Management and Monitoring Plan (GHGMMP) described in Volume 1, Chapter 6, Section 6.9 and Volume 3, Chapter 23, Section 23.5.9 of the EIS. The GHGMMP will describe the technically and economically feasible mitigation measures for the various Project phases and the GHG emission sources. The GHG mitigation measures that will be described in the GHGMMP are the possible electrification for the Project activities that rely on diesel generated power (e.g., stationary gensets and mobile equipment), process optimization, and the possible use of technically and economically feasible renewable energy sources such as solar, wind and batteries. Subject to the availability of adequate data, a comparison will be made for the Project’s GHG emissions profile against other open pit mine operations, this comparison is often referred to as “benchmarking.” The response provided to IAAC-127 describes:

- The GHG monitoring program required to collect the data necessary to maintain compliance with regulatory approvals, permits and authorizations.
- The follow-up program used to determine the effectiveness of the GHG mitigation measures. The effectiveness of mitigation measures could be determined by comparing the results of the GHG monitoring program and/or GHG emissions reported to the federal government with emissions that were predicted in the EIS and/or the benchmarking discussed above.
- Adaptive management and the criteria for implementation. Criteria for adaptive management could include (but are not limited to) annual GHG emissions substantially greater (e.g., 20%) than EIS predictions or benchmarking.

ID:	**IAAC-128**
Attachment:	No

RESPONSE TO IAAC-129

ID:	**IAAC-129**
Expert Department or Group:	IAAC
Guideline Reference	6.2.1 Changes to the atmospheric environment
EIS Reference	6.4.1.3 Mitigation 6.4.2 GHG Emissions Tables 6-23 to 6-26
Information Request:	a. Provide detailed mitigation measures associated with the optimization of infrastructure, such as haul roads and the TMF, to minimize GHG emissions. i. Describe how these mitigation measures and BMPs will minimize GHG emissions, and how individual pollutants would be mitigated or minimized.
Response:	a. In relation to mitigation measures to minimize greenhouse gas (GHG) emissions: i. Detailed design of the Project and mitigation strategies is currently ongoing. There are a variety of GHG mitigation measures that reduce the use of fossil fuels and improve energy efficiency which reduces the consumption of electricity. This includes the mitigation measures associated with optimization of infrastructure (haul roads and tailings management facility [TMF]) to reduce GHG emissions. The optimization of haul roads and infrastructure, such as the TMF, will reduce the transportation and haul distances. Reducing these distances will reduce the GHG emissions of CO_2, N_2O and CH_4. In addition, the buildings at the MacLellan and Gordon sites will comply with modern building standards for energy efficiency which will reduce the amount of energy required for space heating and thereby reduce GHG emissions. The Greenhouse Gas Management and Monitoring Plan (GHGMMP) describes the mitigation measures and BMPs that will reduce the GHG emissions and how individual pollutants would be mitigated or reduced. GHG emissions will be managed throughout life-of-mine based on the GHGMMP described in the Environmental Effects Monitoring Plan (described in Volume 1, Chapter 6, Section 6.9 and Volume 3, Chapter 23, Section 23.5.9 of the Environmental Impact Statement (EIS) that will be finalized during permitting. The GHGMMP describes the technically and economically feasible mitigation measures for the various Project phases, the GHG emission sources and the individual pollutants. The response to IAAC-127 describes the monitoring and follow-up program including the effectiveness of the GHG mitigation measures, adaptive management and the criteria for implementation. The monitoring programs presented in the GHGMMP will describe the process to collect the data necessary to monitor compliance with regulatory approvals, permits and authorizations, help determine the effectiveness of measures implemented to mitigate the adverse effects of the Project, and inform the adaptive management plan. Further details of the monitoring and management plans will be finalized following final mine design, and with further information expected to become available regarding the terms and conditions of the pending authorizations and licenses.

ID:	**IAAC-129**
Attachment:	No

RESPONSE TO IAAC-130

ID:	**IAAC-130**
Expert Department or Group:	SDFN-43
Guideline Reference	2.4 Application of the precautionary approach 6.2 Predicted changes to the physical environment 6.2.1 Changes to the atmospheric environment 6.5 Significance of residual effects
EIS Reference	6.4.3.2 Operation Table 6-27
Information Request:	a. Describe how the assessment of magnitude and significance of change to air quality (L/M/H) considered the exceedances associated with individual pollutants for all Project phases. Provide disaggregated residual effects criteria applications for each air quality value to allow evaluation of the varying magnitude.
Response:	a. A summary of the potential residual environmental effects on air quality during Project construction and operation is provided in the Environmental Impact Statement (EIS) in Volume 1, Chapter 6, Section 6.4.3, and the determination of significance of changes in air quality is described in Volume 1, Chapter 6, Section 6.7 of the EIS. As described in Volume 1, Chapter 6, Section 6.7 of the EIS, the maximum predicted 1-hour average NO_2 concentrations (Gordon and MacLellan sites), and CO and SO_2 concentrations (Gordon site only) are greater than the AAQC but these occurrences are only predicted to occur on the Project boundary, are limited to a maximum of two hours per year and are not near sensitive receptors. Maximum predicted 24-hour TSP and PM_{10} concentrations are greater than the AAQC outside the Project boundary due primarily to fugitive dust emissions, and therefore, an ambient air quality monitoring program will be implemented to monitor ambient TSP, PM_{10} and $PM_{2.5}$ concentrations during construction and operation. With these considerations, and with mitigation and environmental protection measures, the residual environmental effects on air quality at the Gordon and MacLellan sites are predicted to be not significant. In Volume 1, Chapter 6, Section 6.4.3 of the EIS, the magnitude for change in air quality during construction and operation at the Gordon and MacLellan sites was collectively rated (L/M/H) for all substances of interest and averaging periods. The magnitude for change in air quality during operation at the Gordon and MacLellan sites is disaggregated here and rated separately for each substance of interest and averaging period, as follows: • NO_2 Concentrations: The magnitude for change in 1-hour average NO_2 concentration is rated high (H) because the maximum predicted 1-hour average NO_2 concentration at the Gordon site and MacLellan site are greater than the Manitoba Ambient Air Quality Criteria (AAQC). The magnitude for change in 24-hour and annual average NO_2 concentrations is rated low (L) because the maximum predicted 24-hour and annual average NO_2 concentrations at the Gordon site and MacLellan site are greater than 10% of baseline conditions but less than 50% of the respective Manitoba AAQC. • CO Concentrations: The magnitude for change in 1-hour average CO concentration is rated high (H) because the maximum predicted 1-hour average CO concentration at the Gordon site is greater than the Manitoba

ID:	**IAAC-130**
	AAQC. The magnitude for change in 8-hour average CO concentration is rated moderate (M) because the maximum predicted 8-hour average CO concentrations at the Gordon site and MacLellan site are greater than 50% of the respective Manitoba AAQC. • SO_2 Concentrations: The magnitude for change in 1-hour average SO_2 concentration is rated high (H) because the maximum predicted 1-hour average SO_2 concentration at the Gordon site is greater than the Manitoba AAQC. The magnitude for change in 24-hour and annual average SO_2 concentrations is rated low (L) because the maximum predicted 24-hour and annual average SO_2 concentrations at the Gordon site and MacLellan site are greater than 10% of baseline conditions but less than 50% of the respective Manitoba AAQC. • HCN Concentrations: The magnitude for change in 24-hour average HCN concentration is rated moderate (M) because the maximum predicted 24-hour average HCN concentration at the MacLellan site is greater than 50% of the Ontario AAQC. The magnitude for change in 1-hour and annual average HCN concentrations is rated low (L) because the maximum predicted 1-hour and annual average HCN concentrations at the Gordon site and MacLellan site are greater than 10% of baseline conditions but less than 50% of the respective Manitoba AAQC. • TSP Concentrations: The magnitude for change in 24-hour average TSP concentration is rated high (H) because the maximum predicted 24-hour average TSP concentrations at the Gordon site and MacLellan site are greater than the Manitoba AAQC. The magnitude for change in annual average TSP concentrations is rated low (L) because the maximum predicted annual average TSP concentrations at the Gordon site and MacLellan site are greater than 10% of baseline conditions but less than 50% of the Manitoba AAQC. • PM_{10} Concentrations: The magnitude for change in PM_{10} concentration is rated high (H) because the maximum predicted 24-hour average PM_{10} concentrations at the Gordon site and MacLellan site are greater than the Manitoba AAQC. • $PM_{2.5}$ Concentrations: The magnitude for change in $PM_{2.5}$ concentration is rated moderate (M) because the maximum predicted 24-hour and annual average $PM_{2.5}$ concentrations at the Gordon site and MacLellan site are greater than 50% of the Manitoba AAQC. • Metal Concentrations: The magnitude for change in arsenic concentrations is rated moderate (M) because the maximum predicted 24-hour average arsenic concentration at the MacLellan site is greater than 50% of the Manitoba AAQC. The magnitude for change in other metal concentrations is rated low (L) because the maximum predicted 24-hour and 30-day average metal concentrations are greater than 10% of baseline conditions but less than 50% of the respective AAQC. The maximum predicted 1-hour average NO_2 concentrations at the Gordon and MacLellan sites and the maximum predicted 1-hour CO and SO_2 concentrations at the Gordon site during operation are greater than the AAQC but these occurrences are only predicted to occur on the Project Boundary (northeast Project Boundary at Gordon site and south Project Boundary at

ID:	**IAAC-130**
	MacLellan site), are limited to a maximum of two hours per year and are not near sensitive receptors. Maximum predicted 24-hour TSP and PM_{10} concentrations at the Gordon and MacLellan sites are greater than the AAQC outside the Project Boundary due primarily to fugitive dust emissions, and therefore, an ambient air quality monitoring program will be implemented to monitor ambient TSP, PM_{10} and $PM_{2.5}$ concentrations during construction and operation. With these considerations, and with the implementation of mitigation and environmental protection measures, the residual environmental effects on air quality at the Gordon and MacLellan sites are predicted to be not significant.
Attachment:	No

RESPONSE TO IAAC-131

ID:	**IAAC-131**
Expert Department or Group:	HC-03 IAAC
Guideline Reference	3.2.3 Spatial and temporal boundaries 6.1.1 Atmospheric Environment
EIS Reference	7.1.4.1 Spatial Boundaries 7.2.1.1 Methods Volume 4, Appendix D Acoustic Baseline Technical Data Report, Appendix A Volume 5, Appendix C Lynn Lake Gold Project, Noise and Vibration Impact Assessment Technical Modelling Report 4.1.1.1 Baseline Noise Survey Maps 1 and 2
Information Request:	a. Clarify whether traffic from public use of PR 391 is considered in describing baseline sound levels and provide the assessment of any incremental effects. b. Clarify how the baseline monitoring stations (NM1, NM2, and NM3) were selected. Include how these 3 stations were representative of: i. the baseline in the LAA and RAA for noise and vibration; and ii. the conditions for PR 391. If these stations are not representative of the conditions for PR 391, provide additional baseline data or information to depict the baseline conditions for noise and vibration along PR 391 within the LAA, including existing sources of noise such as traffic, and public use of the PR 391 for other activities (e.g., commercial traffic).
Response:	a. Traffic from public use of Provincial Road (PR) 391 was considered in describing baseline sound levels. In the assessment, Receptors 81 and 104 are closest to PR 391. Monitoring results from baseline monitoring station NM2 were used in the assessment to represent the baseline sound level at Receptors 81 and 104. The Baseline Case L_d of 34.3 dBA and L_n of 33.4 dBA represent the acoustic environment of a remote area. Response (b. ii.) provides clarfication on why the NM2 results represent a conservative approach for the assessement. The incremental effects of the Project are assessed as part of the Project Case in Volume 1, Chapter 7, Section 7.4.1 of the Environmental Impact Statement (EIS). As described in the Noise and Vibration Assessment Technical Modelling Report (Volume 5, Appedix C), the Project Case scenarios included the Project-related traffic (i.e., 2 and 12 trucks per hour [i.e., 24/7] during the construction and operation phase, respectively) in the Project scenarios. The incremental effects were assessed by the change in percent highly annoyed (%HA) between the Baseline Case and Total (Baseline and Project) %HA values at these receptors (Receptors 81 and 104). As described in Volume 1, Chapter 7, Section 7.4.1.4, Tables 7-11 and 7-12 of the EIS, a 0.6% and 1.3% incremental change in %HA are predicted at Receptors 81 and 104, respectively during operation. The changes in %HA at the receptors are below the 6.5% target for operation advised in the Health Canada Noise Guidance for Evaluating Human Health Impacts (Health Canada 2017). The transportation assessment report (Stantec 2021) indicates the Average Annual Daily Traffic (AADT) of 100 vehicles per day (vpd) in 2016 for Provincial Road (PR) 391 at Station 2023 (at bridge 7.2 km East of Lynn Lake). The daytime and nighttime traffic volume is assumed to be 90% and 10% of the AADT,

ID:	**IAAC-131**
	respectively (AUC 2020). The vehicle per hour during the daytime and nighttime period is 6.0 and 1.1, respectively. These volumes represent low traffic road and the baseline sound for the receptors closest to PR 391 (i.e., receptor ID 81 and 104) are expected to be similar to that experienced in a remote rural environment. Receptors located at further distance from PR 391 will be less influenced by the traffic noise from PR 391. b. Volume 5, Appendix C (Lynn Lake Gold Project, Noise and Vibration Impact Assessment Technical Modelling Report), Section 4.1.1.1 of the EIS describes how the baseline monitoring stations (NM1, NM2, and NM3) were selected. i. The Health Canada noise guidance (Health Canada 2017) recognizes that both measurements and estimates are acceptable methods in establishing the baseline sound levels for receptors. The baseline sound level at the receptors can be estimated from two data sources. The first data source uses the measurement results from the baseline monitoring program. The second data source uses the estimated baseline sound level for different communities recommended in the Health Canada noise guidance for a receptor location. Volume 5, Appendix C, Sections 4.1.1.2 and 4.1.1.3 of the EIS describe why the results from these three monitoring stations and Health Canada recommended values were representative of receptors within the LAA and RAA. The baseline sound level at most of the receptors is based on the results from one of the three monitoring locations, due to the proximity to the measurement location or similar acoustic environment (i.e., remote locations). Baseline sound levels at receptors located in the community of Lynn Lake were based on levels advised in Health Canada noise guidance for quiet rural communities (i.e., population density of 28 per square km). Volume 5, Appendix C, Sections 4.1.2 of the EIS describes that vibration baseline conditions are not considered in the assessment. In contrast to audible noise, the background environmental ground-borne vibration levels in an outdoor rural area without local human activities is typically below the threshold of human perception (FTA 2018). The typical threshold of human perception of ground vibration is 0.5 mm/s PPV (ISEE 2011); however, the perceptibility threshold varies from person to person. ii. Receptors 81 and 104 are closest to PR 391. Monitoring results from NM2 were used in the assessment to represent the baseline sound level at these receptors. The Ld of 34.3 dBA and Ln of 33.4 dBA represent the acoustic environment of a remote area. The actual baseline sound level could be marginally higher due to the influence of the low traffic volume. However, the quieter baseline sound level is considered a more conservative approach. Volume 5, Appendix C, Sections 4.1.2 of the EIS describes that vibration baseline conditions are not considered in the assessment. In contrast to audible noise, the background environmental ground-borne vibration levels in an outdoor rural area without local human activities is typically below the threshold of human perception (FTA 2018). The typical threshold of human perception of ground vibration is 0.5 mm/s PPV (ISEE 2011); however, the perceptibility threshold varies from person to person.

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	References: AUC 2020. Alberta Utilities Commission (AUC), 2020. Rule 012, Noise Control, version March 2020. Alberta, Canada. FTA 2018. United States Federal Transit Administration (FTA). Transit Noise and Vibration Impact Assessment (FTA Report No. 0123). Prepared by John A. Volpe National Transportation Systems Center. September 2018. Health Canada 2017. Evaluating Human Health Impacts in Environmental Assessment: Noise, published by Health Canada. January 2017. ISEE 2011. International Society of Explosive Engineers Blasters' Handbook, 18th Edition Stantec 2021. Lynn Lake Gold Project Road Operation Traffic Study. March 22, 2021.
Attachment:	No

RESPONSE TO IAAC-132

ID:	**IAAC-132**
Expert Department or Group:	HC-03 IAAC
Guideline Reference	3.1 Designated project 3.2.3 Spatial and temporal boundaries 6.1 Project setting and baseline conditions 6.1.1 Atmospheric Environment 6.2 Predicted changes to the physical environment 6.2.1 Changes to the atmospheric environment
EIS Reference	7.1.4.1 Spatial Boundaries 7.3 Project Interactions with Noise and Vibration 7.4.1 Noise Maps 7-3 to 7-6 Tables 7-7 to 7-12 Volume 5, Appendix C Lynn Lake Gold Project, Noise and Vibration Impact Assessment Technical Modelling Report 2.1 Project Development Area (PDA) 5.1.2.6 PR 391 5.1.3.4 PR 391 Maps 1 to 6
Information Request:	a. Clarify if the use of large haul trucks and their associated noise were evaluated in the noise assessment. Describe how the noise generated by hauling activities was considered spatially along the PR 391. b. Considering the response to Round 1, Package 1, IAAC-10, identify how construction/upgrades to PR 391 are considered in the noise assessment as part of the construction phase of the Project. If construction/upgrades to PR 391 are not considered, update the assessment to include this activity and note any changes to the effects assessment for noise and vibration. c. Provide contour mapping for sound levels along PR 391 within the LAA (comparable to existing contour Maps 7-3 to 7-6) for all phases of the Project and update Tables 7-8, 7-9, 7-11, and 7-12 identifying noise level changes to receptors with updated modelling information.
Response:	a. Volume 5, Appendix C (Lynn Lake Gold Project, Noise and Vibration Impact Assessment Technical Modelling Report), Sections 5.1.2.5, 5.1.2.6, and 5.1.3.4 of the Environmental Impact Statement (EIS) presents the Project-related traffic along Provincial Road (PR) 391 between Gordon site and the MacLellan site. The construction traffic volume of 2 trucks per hour (24/7) is included in the noise model as line sources. That includes mixer trucks, delivery trucks, and fuel trucks. Similarly, the operation phase traffic volume of 12 trucks per hour (24/7) is included in the noise model as line sources. These traffic volumes are based on preliminary truck frequency information provided by Ausenco and conservative assumptions made for haul trucks, fuel trucks, and delivery trucks. The actual Project related traffic volume is expected to be less due to the conservative assumptions. That includes haul trucks, delivery trucks, and fuel trucks. The noise effects related to the PR 391 truck traffic presented in both sections are considered spatially in the assessment. b. PR 391 is under the authority of Manitoba Infrastructure (MI), Region 5. Upgrade activity to PR 391 will be the responsibility of MI Region 5, subject to agreement between Alamos and MI, on a schedule for upgrade activity and issuance of a maintenance fee charged to Alamos. MI, however, may complete some upgrades (e.g., resurfacing of at least one 6-km long section of PR 391) to accommodate anticipated traffic and loading before ore hauling operations start. Therefore, the

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	noise and vibration assessment does not include construction and upgrade activities on PR 391. c. Construction sound level results presented in Table 7-7 and 7-8 (Volume 1, Chapter 7 of the EIS) include the Project-related traffic noise from PR 391 at receptors. Operation sound level results presented in Table 7-11 and 7.12 of the EIS includes the Project-related traffic noise from PR 391 at receptors. Results for the potentially most affected receptors (i.e., ID# 81 and 104) located closest to PR 391 are included in the tables. Maps 3 and 4 of the Noise and Vibration Impact Assessment Technical Modelling Report (Volume 5, Appendix C) have been revised to present the contour mapping for Project-related traffic noise levels spatially along PR 391 within the local assessment area (LAA) for the constructon phase of the Project, attached. Maps 3 and 4 include the eastern and western portion of PR 391, respectively. The noise propagation contour spreading is similar along PR 391. A detail inset figure is included in the map to show the detail noise contour near the closeset receptors (ID104 and ID81). Maps 5 and 6 of the Noise and Vibration Impact Assessment Technical Modelling Report (Volume 5, Appendix C) have been revised to present the contour mapping in similar format for Project-related traffic noise levels spatially along PR 391 within the LAA for the operation phase of the Project, attached.
Attachment:	Appendix A, Attachment IAAC-132

RESPONSE TO IAAC-133

ID:	**IAAC-133**
Expert Department or Group:	CCN-39 CCN-40 CCN-41 SDFN-46 SDFN-47 SDFN-49
Guideline Reference	3.2.1 Changes to the environment 3.2.3 Spatial and temporal boundaries 6.1.9 Indigenous peoples 6.2.1 Changes to the atmospheric environment
EIS Reference	7.1.2.1 Indigenous Engagement, 7.2.1.2 Overview, 7.4.2.4 Project Residual Effects Construction, Tables 7-7 to 7-11, 7-14 and 7-15
Information Request:	a. Clarify how the ambient noise levels based on the 3 monitoring locations (NM1, NM2, and NM3) and the individual receptor points in Tables 7-4 to 7- 15 were selected and describe how they are representative of all rights- based activities for individual Indigenous Nations. If additional receptors representative of rights-based activities for individual Indigenous Nations are identified, provide an updated effects assessment for noise and vibration which includes these Indigenous receptors (i.e., seasonal cabins, residences, gathering and cultural sites/areas) that may be impacted. b. Explain how the receptor locations that would be potentially effected by construction activities were determined, including why there are no receptors within 1 km. c. If additional receptors are identified through engagement, update the assessment of effects for noise and vibration to include them. Provide tables that describe the changes to noise and vibration at these receptor locations.
Response:	a. and b. Noise and Vibration receptor locations include Indigenous Nations and residences in the Project area and current use of lands and resources for traditional purposes (current use) areas as identified through the Indigenous engagement program for the Project, including Project-specific traditional land and resource use (TLRU) studies, as well as a review of publicly available TLRU information sources. Information related to the Indigenous receptor locations was incorporated into the atmospheric environment, acoustic environment, human health, and Indigenous peoples assessments (Chapters 6, 7, 18 and 19 of the Environmental Impact Assessment [EIS], respectively). Indigenous receptors were selected early in the assessment process and represent potential receptor locations rather than specific individual use sites. These potential locations include traplines, lakeshores near fishing locations, and cabins and camps where it there is a potential for extended (overnight) occupancy. Engagement and publicly available current use information revealed no known areas of extended occupancy with 1 km of the Gordon or MacLellan sites. Alamos' conservative approach to assessing effects on current use assumes that these receptors are applicable year-round to anyone who exercises Indigenous rights through traditional activities and harvesting in the area, irrespective of which Indigenous Nation they are from. d. Indigenous input from engagement activities since May 2020 was incorporated into the supplemental filing to the EIS that was provided to IAAC in March 2021. No new sensitive receptors have been identified and therefore no changes to the conclusions of the EIS are proposed. In addition, a direct response to these comments from Chemawawin Cree Nation and Sayisi Dene First Nation (CCN-39, CCN-40, CCN-41, SDFN-46, SDFN-47, SDFN-49) were provided to the Nations on February 2, 2021, and February 8, 2021 respectively, incorporating the information in the response above and seeking additional comment.

ID:	**IAAC-133**
	Alamos' engagement with Indigenous Nations will be ongoing for the life of the Project.
Attachment:	No

RESPONSE TO IAAC-134

ID:	**IAAC-134**
Expert Department or Group:	MCCN-19 SDFN-48
Guideline Reference	6.1.9 Indigenous peoples 6.2.1 Changes to the atmospheric environment 6.3.4 Indigenous peoples
EIS Reference	7.4.1.1 Analytical Assessment Techniques, 7.4.1.4 Project Residual Effects, Tables 7-11, 7-12, 7-14 and 7-15 Volume 5, Appendix C Lynn Lake Gold Project, Noise and Vibration Impact Assessment Technical Modelling Report, 5.0 Model Approach
Information Request:	a. Clarify how noise from blasting has been defined and the differences between air overpressure and sound events. Indicate the differences in potential to contribute to noise levels. b. Assess the noise from blasting and include a description of the methodology of the assessment. c. Confirm there is the potential for blasting-generated noise that may impact receptors, including Indigenous receptors, taking into consideration the response to IAAC-133. i. Describe how receptors may be impacted by noise generated by blasting activities. ii. Describe how noise generated by blasting has the potential to cause nuisance, avoidance behavior, and startle responses to receptors.
Response:	a. The Environmental Impact Statement (EIS) does not address audible sound due to blasting because it is not expected for well-designed blast activities. The industry practice for blast assessment considers the blast-related air pressure and ground vibration only. Blast related noise is sometimes referred to as air overpressure. Air overpressure is the additional pressure above normal atmospheric pressure that is generated from a blast. Air overpressure and sound are different phenomena although both are measured in the units of decibels (dBL). An event with air overpressure and audible sound event of the same value could be quite different. The overpressure may be inaudible due to the low frequency content. Air overpressure often feels like a gust of wind because a well-designed confined blast will generally result in inaudible air overpressure. The usual noise targets associated with community noise standards are based on A-weighted noise (dBA), an adjustment scale that accounts for the human ear sensitivity to different frequencies (i.e., less sensitive at lower frequencies). This A-weighted noise target does not apply to air overpressure. The applicable overpressure target is considered in the EIS Chapter 7 for the identified receptors. The Project's mitigated blast effects meet the overpressure threshold. b. As discussed above for response for IAAC-132a, audible noise is not included in the assessment. Volume 5, Appendix C, Section 5.2.1 of the EIS provides detailed methods for the vibration assessment. c. In a well-designed blast, (as is anticipated for this Project) noise generated by blasting is not anticipated, including at Indigenous receptors. i. In blasting, explosive energy can escape into the atmosphere to generate air overpressure. The air overpressure may be audible (e.g., noise) or inaudible

<table>
<tr><th>ID:</th><th>IAAC-134</th></tr>
<tr><td></td><td>(concussion). In a well-designed mine blast, the energy is used to break rocks. Noise generated directly from a mine blast is not anticipated at a level detectable to the receptors identified in the EIS. Air overpressure may be felt at a distance closer to the blast location. As an example, the wind pressure of 120 dBL is the equivalent of a 20 km/hour wind speed. Ground vibration and concussion wave may cause structure to shake and rattles object hanging on the inside walls. Indirectly, the “interior noise” results from the short-term shaking or rattling of objects which may startle people living inside the structure. The blast will be short-term (i.e., last for a couple of seconds) during the daytime period only.
ii. The assessment included mitigation measures to reduce air overpressure and ground vibration effects below the regulatory threshold at which nuisance, avoidance behavior, and startle response are more likely to occur. In the EIS (Volume 1, Chapter 7) cautionary targets of 10 mm/s and 120 dBL established by Ontario Ministry of Environment, Conservation, and Park (MECP) Guidance were used. During operation, Alamos will use a well-designed blast plan to manage air overpressure and ground vibration effects that have the potential to cause nuisance avoidance behavior, and startle responses to receptors. This will include reducing the blast charge when blasting is to occur in close proximity to receptors (see Volume 1, Chapter 7, Section 7.4.2.3 for further details). The location of receptors is provided in Tables 7-4 and 7-5 and Maps 7-1 and 7-2 of the EIS (Volume 1, Chapter 7).
The mitigated air overpressure and ground vibration effects are summarized in Volume 5, Appendix C, Section 6.2, Tables 6-15 and 6-16. As the perception of nuisance effects is subjective, mitigated effects are presented for all the receptors identified in the EIS. Audible effects from blasting are not anticipated, however air overpressure effects may be experienced that are similar to small gusts of wind. The perception of these effects may be influenced by a number of factors including the sensitivity of the individual, weather conditions, and local surroundings (e.g., trees, buildings, topography).
Mitigated effects at all receptors are below the cautionary targets of 10 mm/s and 120 dBL established by MECP. These targets are commonly used in the mining industry as thresholds below which effects may be perceptible but generally not to a degree to cause annoyance. Based on professional experience, air overpressure effects ranging from 115 dBL to 120 dBL may be felt or sensed. Air overpressure effects below 115 dBL are considered barely perceptible.
The Noise and Vibration Management Plan will include protocols that would serve to inform communities and land users of blasting or an anticipated blasting schedule ahead of time such that local receptors can prepare, and the resulting nuisance and startle responses are reduced.</td></tr>
<tr><td>**Attachment:**</td><td>No</td></tr>
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RESPONSE TO IAAC-135

ID:	**IAAC-135**
Expert Department or Group:	CCN-42 CCN-43 IAAC SDFN-50 SDFN-51
Guideline Reference	6.3.4 Indigenous peoples 6.4 Mitigation measures 8.0 Follow-up and Monitoring Programs
EIS Reference	7.4.1.3 Mitigation 7.4.2.3 Mitigation 7.4.2.4 Project Residual Effects 7.9 Follow-up and Monitoring 23.5.8 Noise Monitoring Plan
Information Request:	a. Clarify how the reduction of blast charges will reduce noise and vibration levels referencing the appropriate technical documents. Provide context for the selection of blast charges and reductions as a standard approach to mitigating noise and vibration impacts. b. Clarify whether the requirement for a reduction in blast charge is also necessary to achieve overpressure level of 125 dBL in areas of unoccupied Crown land in the vicinity of the Project. c. Provide mitigation measures or mechanisms considered for reducing noise and vibration impacts on traditional land use activities besides the receptors already considered in the assessment (i.e., mobile receptors such as land users). d. Describe measures that would serve to inform communities and land users of blasting or an anticipated blasting schedule ahead of time. e. Provide a plan that describes monitoring and follow-up for blasting and vibration. i. Describe the parameters to be measured, the planned implementation timetable for follow-up studies, monitoring methods, reporting mechanisms, regulatory instruments used, characterization of monitoring activities, and production of monitoring reports, and sharing of information. ii. Include specific actions that will be taken to monitor noise and vibration impacts of blasting events and the effectiveness of blasting specific mitigation (i.e., charge reduction). iii. Describe the process for determining how and when it is safe to relax blast charge reductions. Describe the steps that will be taken to inform Indigenous Nations prior to any blast charge increases.
Response:	a. Volume 5, Appendix C (Lynn Lake Gold Project, Noise and Vibration Impact Assessment Technical Modelling Report), Section 5.2.1 of the Environmental Impact Statement (EIS) describes in Equations 3 and 4 that the ground vibration and air overpressure magnitude is directly related to the blast charge per delay and distance between blast charge and receptor. Given the same distance between the blast location and receptor, a reduction in blast charge will reduce the air overpressure and ground vibration effects. Blast charge per delay reduction is a common industry practice to effectively reduce blast effects. The blast plan can reduce the blast charge per delay while maintaining the production objective by controlling the quantity of blast holes and delays. Managing the blast charge per delay is a common and proven industry mitigation practice that can effectively reduce Project-related overpressure and vibration effect.

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In Volume 5, Appendix C (Lynn Lake Gold Project, Noise and Vibration Impact Assessment Technical Modelling Report), Section 6.2.3 of the EIS, specific mitigation measures in terms of blast charge per time delay specifications are provided such that predicted blast effects are below the applicable thresholds. In an adaptive management approach, mitigation measures presented in Section 6.2.3 will be implemented as needed, and monitoring will help to confirm effectiveness.

b. A reduction in blast charge is not necessary to achieve overpressure of 125 dBL in areas of unoccupied Crown land in the vicinity of the Project. Areas of unoccupied Crown land in the vicinity of the Project are not included as receptor locations for the overpressure target of 125 dBL. The target is applicable only at occupied locations where occupants reside seasonally or permanently.

c. Mitigation measures are applicable for reducing blast effect for the identified receptors. The mitigation measures presented in Volume 1, Chapter 7, Section 7.4.2.3 of the EIS (e.g., minimum time delay of 8 milliseconds between holes in blasts, and reduced blast charges) would be applicable and effective to reduce the blast effect for other receptors/traditional land use activities as well.

d. A communication mechanism for providing data will be established to distribute information and accept inquiries from Indigenous Nations and land users. Alamos maintains a local office/presence in Lynn Lake that facilitates ongoing communications with members of the local community, stakeholders, and interested government officials (on an as needed basis). Alamos will maintain an office at the mine site and will consider maintaining a smaller office in Lynn Lake during Project operation to further facilitate communication. Indigenous communities and land users will be informed on an ongoing basis regarding blast monitoring results or an anticipated blasting schedule ahead of time.

e. The following sections provides high level summary from the Noise and Vibration Management Plan

  i. NVMP descriptions as follows:

  - Measurement Parameters:
    - Noise: A-weighted, C-weighted, and linear equivalent sound level in one third octave band and statistical sound levels, logging period range from one-mintue to one-hour.
    - Vibration: time histories and fast fourier transform (FFT) of the waveforms as ground vibration peak particle velocity (PPV) in mm/s and air blast overpressure in dBL.
  - Schedule:
    - Noise: One noise monitoring is recommended before construction to quantity the baseline sound level at the receptors. During construction, monthly monitoring is recommended because the activities level will vary during different construction phases. Noise effects during the initial operation years are expected to be less than the peak years, quarterly monitoring frequency is recommended. During Gordon site Year 2 and MacLellan site Year 7, noise effects are expected to be highest due to the quantity and type of noise emission equipment. Therefore, the monitoring frequency is increased monthly. During Gordon site Year 3 and MacLellan site Year 8 (e.g., year after peak

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	year), the monitoring frequency will be scaled back to quarterly. The remaining operation years monitoring frequency will be annually. – Vibration: At the Gordon site, daily monitoring is recommended during the first month of production blast and when blast is closest to receptor ID 76. The monitoring frequency can reduce to weekly if the 5-day average of daily results are below threshold. Furthermore, the frequency can reduce to monthly if the 4 weeks average of weekly results are below threshold of 10 mm/s and 120 dBL at receptor ID 76. At the MacLellan site, daily monitoring is recommended during the first month of production blast and when blast is closest to receptor ID 86. The monitoring frequency can reduce to weekly if the 5-day average of daily results are below threshold. Furthermore, the frequency can reduce to monthly if the 4 weeks average of weekly results are below threshold of 10 mm/s and 120 dBL at receptor ID 86. • Methods and characteristics of Monitoring Activities: – Noise: Long-term continuous noise monitoring programs will be implemented for the Project. The long-term noise monitoring can be performed using dedicated sound level meters to obtain the noise data at selected locations. A continuous noise monitoring time period of multiple days at multiple locations. This longer period provides sufficient monitoring duration to characterize the acoustic environment. The monitoring can be conducted during different Project phases such as pre-construction, construction, operation, and closure phases. Four locations (receptor ID 76 and ID 77) are proposed for the Gordon site. Three locations are proposed (receptor ID 85, ID 86, temporary and permanent workers camp) for the MacLellan site. – Vibration: Blasting events will occur on a regular basis (i.e., daily). Long-term vibration monitoring stations will be used for the Project. Dedicated instrumentation that measures ground vibration and air blast overpressure will be installed at the multiple locations. Three locations (receptor ID 76, ID73, and one location along the PDA boundary) are proposed for the Gordon site. Three locations are proposed (receptor ID 86, permanent workers camp, and one location along the PDA boundary) for the MacLellan site. The location along the PDA should be closest to the blast activities. This location will vary as blasting in the pit progress during the production years. The instruments will be set up with pre-set trigger levels that measure automatically during a blast event. The ground vibration amplitude in three orthogonal directions and the corresponding frequencies will be recorded. Similarly, the air blast overpressure amplitude and the corresponding frequency will be recorded. • Reporting mechanism: The report includes section that describe the method, results, and action plans associated with the NVMP. Records that are generated from NVMP activities are maintained, retained and stored in accordance with the EMMP standards. Records associated with noise and vibration related activities include: – Training and competency records such as training logs, copies of certifications, and education (as required);

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	– Contractor/supplier communications regarding noise and vibration management; – Incident reports; – Formal communications records (particularly for regulatory communications); – Monitoring measurement parameters and site observations; – Noise or vibration complaints from the community (i.e. complaint investigation forms, telephone records, and community liaison meetings); and – Non-conformities, corrective and preventive actions related to noise and vibration. Records are stored in either hardcopy and/or electronic formats and maintained in such a way that they are readily retrievable and protected against damage, deterioration, or loss. • Regulatory instrument used: – Noise: High precision Type 1 integrating sound level meters capable of recording hourly sound pressure levels in dBA is recommended to assess the spectra characteristic of noise sources (i.e., tonality, low frequency noise), sound pressure levels at the one-third octave band are required. In addition, audible recording capability is recommended to identify non-representative events for data analysis. Battery powered units to complete automated (unattended) noise monitoring. Sound level meters should be capable of recording equivalent sound level and statistical sound level with different time period settings. Sound level meters must be calibrated in the last two years by manufacturer or independent accredited laboratory. A copy of the calibration certificates will be appended to the monitoring report. – Vibration: Four channel seismographs should be used to record ground vibrations and air blast overpressure. Three channels will be used to measure ground vibration in three orthogonal directions (i.e. longitudinal, transverse and vertical). The vibration transducers should log the time histories of the waveforms as peak particle velocity (PPV) in mm/s. The fourth channel will measure the air blast overpressure in dBL. The airblast microphone should have a flat (linear) response from 2 to 200 Hz. • Reporting: Reports from monitoring programs will be submitted annually to regulatory authorities and shared with interested Indigenous communities and stakeholders. • Information Sharing: A communication mechanism for providing data will be established to distribute information and accept inquiries from Indigenous communities and land users. Alamos maintains a local office/presence in Lynn Lake that facilitates ongoing communications with members of the local community, stakeholders, and interested government officials (on an as needed basis). Alamos will maintain an office at the mine site and will consider maintaining a smaller office in Lynn Lake during Project operation to further facilitate communication. Indigenous communities and land users will be informed on an ongoing basis

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	regarding blast monitoring results or an anticipated blasting schedule ahead of time. ii. The Noise and Vibration Management Plan (NVMP) uses adaptive management approaches that includes corrective action when the vibration effects exceed the thresholds presented above in responses e(i). Correction action will be required to reduce the effects. Mitigation measures (EIS Secton 7.4.2.3) will be the primary correction actions that should be considered. In addition, any potential vibration exceedance should be investigated whether it is correlated with any complains incident. Post corrective action monitoring will be required to validate if the corrective action is effective and further actions or enhancements may be required. iii. Vibration monitoring at the most impact receptors (i.e., closest to the blast location) will be conducted at various frequency (i.e., daily, weekly, monthly) throughout the production phase. The monitoring results will determining how and when it is safe to relax blast charge reductions. If the monitoring results (i.e., 5-day average of daily results) are consistently below the vibration threshold, relaxation of blast charge reduction can be considered. A communication mechanism for providing data will be established to distribute information and accept inquiries from Indigenous communities and land users (see the response to d. above).
Attachment:	No

RESPONSE TO IAAC-136

ID:	**IAAC-136**
Expert Department or Group:	CCN-131 HC-04 MCCN-102 MCCN-103 SDFN-152
Guideline Reference	6.4 Mitigation Measures 8.0 Follow-up and Monitoring Programs
EIS Reference	7.1.2.1 Indigenous Engagement 7.4.1.3 Mitigation 7.4.2.3 Mitigation 7.9 Follow-up and Monitoring 23.5.8 Noise Monitoring Plan
Information Request:	a. Provide details for the Noise Monitoring Plan. i. Describe the follow-up program. ii. Describe the parameters to be measured, the planned implementation timetable for follow-up studies, monitoring methods, reporting mechanisms, regulatory instruments used, characterization of monitoring activities, and production of monitoring reports, and sharing of information. iii. Describe the monitoring plan for noise levels at key locations where human health and exercising of rights may be impacted, such as permanent or seasonal residences, to validate the assessment models and predictions. Describe how noise monitoring will inform proactive adaptive management prior to complaints. iv. Describe how noise complaints will be addressed, including what determinant(s) will be used to decide if there is a need for corrective action, what corrective actions will be used, what the timelines are for complaint resolution (e.g., within a specified number of days of receiving the complaint), and how the plan will be communicated to potentially impacted people in the RSA. v. Describe how Indigenous Nations will be involved in the development and implementation of the Noise Monitoring and Follow-up Plan.
Response:	a. The Noise and Vibration Management Plan (NVMP) includes the following: i. The NVMP establishes the following performance objectives for the management of noise and vibration that considers the Project's interactions and compliance obligations: • Reduce adverse environmental effects through implementation of mitigation measures, monitoring, and adaptive management. • Meet or exceed noise and vibration regulatory requirements. • Resolve noise and vibration issues through a complaint investigation process. • Verify Project-related noise and vibration compliance as committed to in the Environmental Impact Statement. ii. Please refer to response in IAAC-135 e. i. for the descriptions of measurement parameters, schedule, monitoring methods, reporting mechanisms, regulatory

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instruments used, characterization of monitoring activities, and monitoring reports, and information sharing.

iii. Please refer to response in IAAC-135 e. i. for a description of the monitoring plan for noise levels at key locations. The NVMP uses adaptive management approaches that includes corrective action when the vibration effects exceed the thresholds presented above in responses e. i. Correction action will be required to reduce the effects. Mitigation measures (Volume 1, Chapter 7, Secton 7.4.2.3 of the EIS) will be the primary correction actions that should be considered. In addition, any potential vibration exceedance should be investigated whether it is correlated with any complaint incident. Post corrective action monitoring will be required to validate if the corrective action is effective and further actions or enhancements may be required.

iv. During all Project phases, a Public Complaints Protocol will be implemented to address noise or vibration complaints from the community in a timely manner. Complaints can be received formally or informally, following a process that will be posted on the company's website. A formal complaint will include correspondence, phone calls, comments posted to the company's website or emails sent to Alamos specifying a concern or making a claim.Informal complaints will include issues or concerns expressed verbally to LLGP employees, as well as concerns raised by individuals through social media, including Facebook, Twitter and other online platforms. Complaints will be accepted anonymously, although Alamos notes that responses will only be provided to individuals who provide contact information.

The Noise Complaint Investigation Form and Vibration Complaint Investigation Form will be available to the public. Information requests in these forms provide the framework for noise complaint investigation. The noise and vibration complaint investigation forms will be incorporated as part of the complaint investigation and resolution process in the EMMP.

In every instance, the receipt of a formal or informal complaint will require the employee who receives it to complete a Public Complaints and Grievances Form and deliver it promptly to the External Affairs Manager. All formal and informal complaints will be reviewed, as described below.

The External Affairs department or its delegates will ensure complaints from the public are properly addressed. The External Affairs Manager will begin and oversee a process that consists of the following steps:

- Registration.
- Initial Assessment.
- Investigation.
- Resolution and recording of appropriate actions taken. The need for corrective action will be determined based on the severity of the complaint, correlation between complaint events and monitoring data, and the likelihood of the potential for the cause of the complaint to re-occur. Corrective actions may include, but are not limited to, increased communication of site activities likely to cause noise, changes to the timing of activities likely to cause noise, and changes to the methodology of the activities likely to cause noise.

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Response to the complainant, which may include but is not limited to a direct response to the complainant, and communication with the surrounding community of corrective actions taken
Follow up as required.

v. Alamos is committed to open and transparent engagement throughout the life of the Project. Opportunities will be provided to discuss interests and resolve issues related to the Project. Alamos will maintain ongoing communication with Indigenous Nations, stakeholders, provincial regulators, including other provincial and federal departments, as necessary regarding implementation of the Project’s EMMP through construction and operation, and into decommissioning.

Information on conceptual monitoring and management plans was provided to Indigenous Nations on April 21 (registered mail) and April 22 (email), 2021. Alamos has not received any comments from Indigenous Nations regarding this material to date.

As results become available from the follow-up and monitoring program, they will be shared with Indigenous Nations, stakeholders, and regulators in a fashion, frequency, and format determined to be appropriate to the applicable audience. The reporting will be used to inform the adaptive management framework.

A communication mechanism for providing data will be established to distribute information and accept inquiries from Indigenous Nations, the public, and stakeholders. Alamos maintains a local office/presence in Lynn Lake that facilitates ongoing communications with members of the local community, stakeholders, and interested government officials (on an as needed basis). Alamos will maintain an office at the mine site and will consider maintaining a smaller office in Lynn Lake during Project operation to further facilitate communication.
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RESPONSE TO IAAC-137

ID:	**IAAC-137**
Expert Department or Group:	IAAC
Guideline Reference	6.6.1 Effects of potential accidents and malfunctions
EIS Reference	22.5 Effects Assessment of Potential Accidents or Malfunctions
Information Request:	a. Identify and describe the worst-case scenario for each type of accident and malfunction scenario. Provide the quantity and rate of release of the contaminants and other materials for each worst-case scenario.
Response:	a. As described in Volume 3, Chapter 22, Section 22.5 of the Environmental Impact Statement (EIS), there are five potential accidental events or malfunctions that may result in adverse effects to the valued components (VCs), including tailings management facility (TMF) malfunction, release of untreated contact water, fuel and hazardous material spill, mine rock storage slope failure, and vehicle accident. The worst-case scenario for each of these are as follows: • As discussed in Volume 3, Chapter 22, Section 22.5.1, the worst-case scenario for the TMF failure would be a failure at the 'ultimate' stage of construction when the TMF will have a capacity to store 23.1 Mm^3 of tailings. The assessment that the ultimate stage is the worst case is based on the facts that this stage has the largest tailings and water volume. The actual potential release volume and rate of release will be estimated as a part of the dam breach assessment (DBA) that will be performed during Project detailed design prior to construction. • A worst-case release of untreated contact water has currently not been estimated; these estimates will be undertaken as part of detailed engineering design and contingency planning. A release from the TMF is considered the worst case for release as the tailings water is not suitable for discharge without treatment and the volumes stored will be larger than the capacity of the collection pond. The actual potential rate of release will be determined as a part of the DBA. • At the MacLellan site, the likely location of a slope failure for the mine rock storage area would either be at the east or south end of the stockpile. At the Gordon site, the likely location of a slope failure would either be the east or west end of the stockpile. The stockpile slope configurations for both the MacLellan and Gordon sites have been designed for a minimum factor of safety against static and pseudo-static loading of 1.3 based on the guidelines outlined by Hawley and Cunning (2017) “Guidelines for Mine Waste Dump and Stockpile Design”. In the unlikely event of a failure at the mine rock storage area, the estimated quantity of material that would slump would be about 600,000 m^3 with a projected runout distance from 50 to 100 m. This assumes a block sliding failure mechanism over a perimeter length of 200 m where the mine rock stockpile is highest relative to the existing ground surface. • The US Department of Transportation’s (US DOT) Pipeline and Hazardous Material Safety administration maintains incident records of hazardous material releases in the United States. The records include releases from sites

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	and during a wide range of transportation modes such as railway, maritime shipping and highway transport. The US DOT reported 18,834 highway spills incidents over the last 11 years from 01/01/ 2010 and 31/12/2020. Canadian spill incident statistics are difficult to obtain and not publicly available. Canadian spill databases are typically maintained by the provinces and only made available through freedom of information requests. To estimate the spill volumes for the Project at the identified spill locations, the US DOT highway spill record for the 11 years covering 2010 to 2020 was accessed for further analysis.Worst- case scenarios for diesel, ammonium nitrate and sodium cyanide include: – Of 18,834 US DOT highway spill incidents reported from 2010 to 2020, 402 were recorded as diesel fuel spills (2.1% of all spills), of which 50 or 12.4% of all diesel spills were reported to have entered either a waterway or sewer. The average diesel spill release volume was 1,394 US Ga (5,277 L) which was 21% of the average total tanker capacity reported for diesel spills. Based on a ratio of spill volume to tanker capacity of 34% (85%ile), a reasonable spill volume was estimated to be 15,066 L. For the purpose of modelling, a worst-case scenario is assumed that the total spill volume of 15,066 L occurs over a period of 1 hour. – Of the US DOT reported 18,834 highway spills incidents, 52 were recorded as ammonium nitrate spills (0.28% of all spills), of which two spills were reported to have entered either a waterway or sewer. When the US DOT database was filtered for spills where solid material was shipped in sub-containerization (i.e., bags, drums or IBC-intermediate bulk containers) the material was packaged in sub-containers ranging from 50 – 2,000 lbs (22.7 – 909 kg). The average spilled weight was 118 lbs (54kg) up to three sub-container volumes released (i.e., 3 - 50 lb bags) although in most cases a single sub-container was breached. When sub-containerized, the spilled weight ranged from 0.5% - 45% of the total shipped weight. The maximum solid form, sub-containerized ammonium nitrate release was 250 lbs (113.6 kg). Review of the US DOT spills database indicates that when sub-containerized, ammonium nitrate releases volumes are small relative to total shipping capacity and the released volumes are typically a single sub-container. Thus, based on review of the US DOT spills database simulating an ammonium nitrate release mass of 113.6 kg will be a conservative, credible and realistic representation of a worst-case release. For the purpose of modelling, a worst-case scenario is assumed that the spill occurs over a period of 1 hour. – Just two sodium cyanide releases were reported in the highway spillage category of the US DOT database. Of these, one release was of 100 lbs (45.5 kgs) from a 1,000 kg IBC and the other was a release of 1 lbs (0.45 kg) from a 3000 lbs (1,364 kg) shipment. In neither case was environmental damage or release to a waterbody or sewer reported. Sodium cyanide is commonly shipped in briquette form making it very stable and reducing susceptibility to spill. Therefore, mass of sodium cyanide that will be simulated in the accidental release will be 50 kg (110 lbs). For the purpose of modelling, a worst-case scenario is assumed that the spill occurs over a period of 1 hour.

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	- A worst-case scenario for a vehicle accident would be one resulting in the loss of life.
Attachment:	No

RESPONSE TO IAAC-138

ID:	**IAAC-138**
Expert Department or Group:	ECCC-37, IAAC, MMF-21
Guideline Reference	6.1.2 Geology and geochemistry 6.1.3 Topography and soil 6.6.1 Effects of potential accidents or malfunctions 6.6.2 Effects of the environment on the project
EIS Reference	5.2.1 Climate and Meteorology 5.2.5.1 Glacial and Post Glacial History 5.2.5.3 Terrain, Surficial Geology, and Permafrost 21.4.1 Climate and Climate Change 21.4.2 Geological Hazards Table 21-1 22.4.6 Open Pit Slope Failure 22.4.7 Ore, Overburden and Mine Rock Stockpiles/Storage Areas Slope Failure 22.5.4 Ore, Overburden, and Mine Rock Storage Area Slope Failure
Information Request:	In providing a response, refer to Round 1, Package 1, IAAC-23 and IAAC-24 for consideration of permafrost surrounding Project activities. a. Describe how projected climate changes, including those identified as important to the Project by the proponent (e.g., extreme precipitation events, PMF, drought) have been or will be considered or accommodated for in Project design for all Project phases. b. Assess the potential for extreme precipitation events and the potential effects to Project infrastructure (i.e., TMF as in IAAC-141 and bridge infrastructure). Describe any additional mitigation measures and/or follow- up, as required. c. Assess the potential effects of permafrost as a result of climate change effects (e.g., potential for thaw, settlement, and instability; changes to groundwater volume), on the Project. Describe the potential for slope failures and geotechnical risks as a result of permafrost changes. d. Provide and describe a follow-up and monitoring plan for the geotechnical risks such as slope stability, landslides, and changing permafrost or other related conditions (e.g., changes to groundwater volume) in the Project area.
Response:	a. As described in Volume 3, Chapter 21, Section 21.4.1.2 of the Environmental Impact Statement (EIS), climate change is an important consideration in Project planning because interactions may occur that could result in changes to Project schedule or damage to Project infrastructure and equipment. Project design will consider normal and extreme weather conditions that may arise (e.g., storms, precipitation, flooding/ice jams, and drought) and will include measures for climate adaptation. For example, as described in Section 22.4.1 in Chapter 22 of the EIS, the tailings management facility (TMF) is equipped with an emergency spillway to allow for safe routing of precipitation to prevent dam overtopping in the event of an extreme precipitation event. The design flooding event for the operation of the Project was selected as 1/3 between the 1 in 1000-year and the probable maximum flood, according to the Canadian Dam Association Dam Safety Guidelines. The design flooding event for the post-closure phase of the Project was selected as 2/3 between the 1 in 1,000-year and the probable maximum flood. Additionally, the potential effects of extreme weather, including storms,

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	precipitation, flooding/ice jams, and drought will be considered in Project design and operation, including the selection of materials and equipment. For example, pumps will be sized to accommodate extreme weather events and other equipment will be selected to withstand snow loads and freezing conditions as well as ice jams. These materials and equipment will be “weather-proof” for all project phases. Regular maintenance and inspections will be conducted to identify weather-related failures or out-of-specification operating conditions and help the Project comply with applicable design criteria, best management practices, codes, and standards, and to maintain reliability of the Project. These design criteria, codes and standards will include the latest projections related to climate change. Please also see the response to IAAC-139 with respect to climate-related effects on the Project including extreme weather (e.g., drier and warmer conditions) and management of fire risk. b. As described in Volume 3, Chapter 21, Section 21.4.1.2 of the EIS, extreme precipitation from rainfall and/or snowmelt has the potential to result in flooding, ice jams, erosion, and other events such as washouts on access roads, or an overabundance of water in collection ponds or the Project’s water drainage/diversion system. These events could lead to the erosion of topsoil; the degradation of soil quality, structure and stability; changes to slope stability; and/or the failure of erosion or sediment control structures. This could result in a possible failure of Project infrastructure, which has been assessed in Chapter 22. The assessment included failure of the TMF, release of untreated contact water, fuel and hazardous material spill, and mine rock storage area slope failure. In the unlikely event of a major industrial accident or malfunction involving a large-scale release into the environment (e.g., major TMF failure with discharges of tailings into local waterbodies and other habitats outside the Project Development Area, or spill from vehicle malfunction or collision into a waterbody), there is a potential for significant residual adverse effects to surface water and fish and fish habitat. Proposed mitigation measures, primarily through Project design, are provided in Volume 3, Chapter 22, Section 22.5 of the EIS. Mitigation and management measures will be refined during detailed Project design. In particular, Alamos will develop contingency planning and implement engineering and quality controls during the design, construction, operation and decomissioning phases to comply with applicable design standards and best practices. c. Permafrost degradation as a result of climate change is well understood and known to have implications on terrain stability (current and future). As detailed in the Soil and Terrain Baseline Technical Data Report/Validation Report (Volume 4, Appendix E of the EIS), localized degradation of permafrost is already occurring within the Project local study area and regional study area. Key examples documented both as part of the terrain mapping and field inspection program include the occurrence of thermokarst and thaw subsidence, mainly in terrain landscape units characterized by the presence of thick organic deposits. This thermal degradation process has the potential to affect ground stability, substantially change soil moisture content, alter soil nutrient availability and influence local vegetation community composition. Potential effects of climate change-induced permafrost degradation on the Project are anticipated to be limited, mainly because the construction activities planned at major Project infrastructure sites are expected to require the excavation of the overburden and organic topsoil; thus, removing the layer of permafrost susceptible to potential thaw settlement. In the eventuality that permafrost soils would not be removed as part of

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	Project construction activities, then mitigation techniques to reduce the effects of permafrost degradation would be implemented. As described in the Soil and Terrain Baseline Technical Data Report/Validation Report (Volume 4, Appendix E of the EIS), and summarized in Volume 3, Chapter 21, Section 21.4.2.2 of the EIS, the surficial materials found within the Project area are characterized by an overall low susceptibility to rapid mass movements such as landslides. Within the Project area, the potential for slope failures as a result of permafrost changes is also expected to be low. Field inspections indicated that permafrost was largely limited to wetlands, predominantly in peat plateaus. The review of preliminary geotechnical data associated with investigation conducted in 2015 (Golder) suggested the presence of permafrost extending from the peat deposits into the underlying fine-grained glaciolacustrine sediments. Although the melting of permafrost in glaciolacustrine sediments could lead to instabilities (including low-angle landslides), the potential for slope failures as a result of permafrost changes is expected to be low, especially since it is expected that permafrost soils will be excavated as part of Project construction activities. In the eventuality that permafrost soils would not be removed as part of Project constructions activities, then mitigation techniques to reduce the risk for potential slope failures will be implemented. d. A key objective of any terrain and/or geotechnical-related monitoring includes monitoring terrain stability as well as evaluation of the effectiveness of the mitigation approaches for the construction and operation of mining infrastructure. A typical monitoring program would include monitoring the performance of infrastructure in: different terrain units or soil types; drainage conditions and erosion potential; permafrost condition and potential for thaw degradation; ground subsidence and/or mass movements. Applicable evaluation methods may include both desktop and field-based monitoring techniques. Desktop-based monitoring activities could be conducted using remote sensing technology such as Synthetic Aperture Radar (SAR) data; Surface Subsidence & Uplift Measurement (SSUM) monitoring using Interferomic Synthetic Aperture Radar (InSAR) data; and/or Light detection and ranging (LiDAR) data. Field-based monitoring activities specific to permafrost stability could include active layer measurements and/or the installation of thermistor cables. Geotechnical monitoring instruments may include, for example, hydrological sensors (e.g., vibrating-wire piezometers and other types) and ground displacement sensors (e.g., surface gauges and inclinometers). The current knowledge of terrain and geotechnical conditions at Gordon and MacLellan sites, including constraints (e.g., permafrost and poorly drained terrain) and potential geohazards (e.g., landslides), does not currently prescribe the implementation of such monitoring techniques. As detailled above (IAAC-138 response c), the potential effects of permafrost degradation on the Project are anticipated to be limited and mitigation techniques to reduce permafrost degradation will be implemented. The continuous risk management, control and mitigation strategies that will be implemented as part of the various development phases of the Project are expected to be adequate to manage potential geotechnical risks that could occur in the Project area. These risk assumptions and implications for a monitoring plan specific to terrain stability will be re-evaluated as part of the Project's detailed-design stage.
Attachment:	No

RESPONSE TO IAAC-139

ID:	**IAAC-139**
Expert Department or Group:	IAAC
Guideline Reference	6.6.1 Effects of potential accidents or malfunctions 6.6.2 Effects of the environment on the project
EIS Reference	1.4.1.2 Provincial Requirements Table 1-3 21.4.1 Climate and Climate Change 21.4.3 Forest Fires 22.4.9 Fire/Explosions
Information Request:	a. Identify and describe Project activities that may contribute to wildfire risks during wildfires seasons or wildfire incidents. Describe how Project activities (i.e., fuel storage) and schedules considered the risks of wildfire. b. Describe the open burn techniques that will be used for land clearing activities during all phases of the Project and provide an assessment of the risks associated with conducting these techniques during wildfire season or incidents of wildfires within RAAs, LAAs, and the PDA. c. Should open burning be required outside of the PDA, describe how the proponent intends to notify local communities and Indigenous Nations. d. Describe how permits under The Wildfires Act may contribute to or minimize the risks associated with operation during wildfire seasons, or during incidents of wildfires. e. Describe how climate change factors and land clearing for the Project (including through open burn techniques) were assessed in the potential future risks of wildfires. Describe how the Project has potential to contribute to wildfire risks. f. Provide all applicable mitigation measures, emergency response procedures, or changes to Project operations that would be applied during wildfire seasons or incidents of wildfires.
Response:	a. Project activities and schedules (including open burn, and industrial operations including fuel storage) will consider and control the risks of wildfires through compliance with *The Wildfires Act* (Manitoba) (see response to b. and d. below) and implementation of the Emergency Response and Spill Prevention and Contingency Plan as part of an Environmental Management and Monitoring Program instituted for the Project (see Chapters 22 and 23 of the Environmental Impact Statement [EIS]). The objective of the plan is to provide for emergency preparation and response including accidents involving hazardous substances, medical emergencies, explosion and fire. b. Any open burn technique will be performed in accordance with *The Wildfires Act*. A burning permit will be acquired during the April to November fire season when applicable. Fires will not be started if conditions could lead to the fire burning out of control and controls must be in place prior to burning material, including a minimum 6 m wide strip of land free of inflammable material, or covered by snow or water. Burning material will not be placed where it could cause a fire to spread and burning will be supervised until the fire is out. The risks associated with this technique include the potential for temporary effects to air quality. It is also possible that a Project fire could spread to surrounding areas. Reasonable

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	precautions will be taken to avoid fires and limit the potential for fires beyond the Project Development Area (PDA) (e.g., cleared buffers). Employees will be trained in fuel handling, equipment maintenance, and fire prevention and response measures and fire prevention and suppression systems will be maintained on-site. Furthermore, emergency response procedures will be in place to provide timely and effective response to fires, and containment within the PDA. Protocols for communication with local authorities will also be included in these emergency response procedures. c. Should open burning occur outside the PDA, Volume 3, Chapter 23 of the EIS further describes the environmental management plans that will be in place for the Project, which will include communication roles and responsibilities, training requirements, and mitigation/response measures in the event of an unplanned accident or malfunction. Alamos will also follow the requirements stipulated in the burning permit that typically include notifying the local Manitoba Conservation and Climate District Office, the nearest local fire department, the nearest local hospital, and the Town of Lynn Lake. d. Under *The Wildfires Act* (Manitoba), no person is allowed to start an outdoor fire in a burning permit area, so designated by regulation, during the wildfire season, except under the authority of a burning permit. Open fires are prohibited from April 1 to November 15 annually, except under a burning permit. The burning permit would include a set of conditions that would require the permittee to keep a fire under control, provide sufficient responsible persons and equipment at the site of the fire to extinguish it if necessary, and to extinguish all fires authorized by the permit on the cancellation, suspension, or expiry of the permit. Adhering to conditions stipulated in a burning permit will contribute to mitigating the risks associated with set fires during the wildfire season. During the wildfire season or during incidents of wildfire, the Manitoba government may implement fire and travel restrictions within the province. The restrictions would place limits on any activity that has the potential to cause a wildfire during high danger conditions. These activities include industrial operations and permits for outdoor fires. For industrial operations, such as a mine, no person is allowed to operate machinery, vehicle, boiler, smokestack, chimney, incinerator or other equipment without an effective means of preventing the escape of fire, sparks, or other emissions capable of causing fire, during the wildfire season, in a burning permit area. An officer may request that an industrial operation, within a burning permit area, submit a Fire Control Plan for approval. As part of operations, Alamos intends to maintain a cleared buffer around critical mine infrastructure to impede the spread of fire from a facility fire to the surrounding woodlands and to protect the facilities from an incident wildfire. e. An assessment of effects of the environment on the Project related to climate and climate change, including risk of wildfire, is described in Volume 3, Chapter 21, Sections 21.4.1 and 21.4.3 of the EIS. Wildfires are considered one of Manitoba's regional environmental hazards. Predictions of future climate change for the province suggest that Manitoba will experience warmer and wetter winters, and longer, warmer, and drier summers. Extreme weather, including heat waves, droughts, floods, and extreme storms, are expected to become more frequent. Heat waves and extreme storms (i.e., lightning) can contribute to increased wildfire risk. Climate change projections using two scenarios (i.e., intermediate carbon emissions and high carbon emissions) have been conducted for the Northern Boreal Shield in Manitoba, where the Project is located. The projections indicate

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	that the mean annual temperature in the Northern Boreal Shield is predicted to increase by 1.8° C and days with temperatures over 30° C are expected to more than double. Extreme temperatures and storms (i.e., lightning) could potentially affect the Project in several ways, as described in Volume 3, Chapter 21, Section 21.4.1.2 of the EIS. It is expected that future climate change could result in extreme temperatures and an increase in the frequency and magnitude of storm events, that could contribute to the incidence of wildfires. During electrical storms, a lightning strike could ignite a forest fire which could potentially damage Project infrastructure and equipment and/or interrupt operations. The resulting damage could therefore result in effects to the environment (e.g., releases to the ground surface, surface water, and atmosphere). Climate change is viewed as a risk to the mining industry, Canada-wide. Mitigation measures are primarily achieved through design, engineering, and infrastructure adaptation as noted in Volume 3, Chapter 21, Section 21.4.1.3 of the EIS. The potential effects of climate and extreme weather will be considered and incorporated into the planning, design, construction, operation, and decommissioning/closure of the Project to reduce the potential for long-term damage to infrastructure and equipment. The effects of climate and extreme weather, related to the risk of wildfires, will be considered and incorporated into the planning, design, construction, operation, and decommissioning/closure of the Project, as Alamos will consider the inclusion of Fire Smart principles into the Project as part of detailed design. As described in Volume 3, Chapter 21, Section 21.4.3.3 of the EIS, Alamos will adhere to the National Fire Code of Canada and *The Fires Prevention and Emergency Response Act* (of Manitoba). Regular maintenance and safety inspections will be conducted on Project infrastructure and equipment, onsite fire prevention and response equipment will be provided and maintained, and employees will be trained in safe fire response. f. Additional fire prevention provisions are described in Volume 3, Chapter 22, Section 22.4.9 of the EIS, including the implementation of a cleared buffer which will be maintained around critical mine infrastructure to impede the spread of fire from a facility fire to the surrounding woodlands and to protect the facilities from a wildfire. Regular maintenance and inspections will also be conducted to avoid the deterioration of Project infrastructure and equipment, to help the Project comply with applicable design criteria, best management practices, codes, and standards, and to maintain reliability of the Project. These design criteria, codes and standards will include the latest projections related to climate change. The Project will affect 122.6 ha and 498.9 ha of productive forest land at the Gordon and MacLellan sites, representing 0.1% and 0.3% of the total productive forest land in Forest Management Units 72 and 71, respectively. Land clearing (i.e., timber removal) will be conducted in accordance with *The Forest Act* (Manitoba). Merchantable timber cleared may be salvaged and used, if feasible, to enhance carbon storage, or it will be made available to local communities for fuelwood. The potential for the Project to contribute to wildfire spread is associated with uncontrolled open burning. See response to b. above for the technique to be employed for conducting open burns under *The Wildfires Act* and the preventative measures to be utilized to lessen the risk of wildfire. Mitigation measures for the wildfire season are described in Volume 3, Chapter 22, Section 22.4.9 of the EIS and include: fire prevention and suppression systems including water supplies, sprinklers, fire extinguishers and other firefighting

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	equipment. A cleared buffer will be maintained around critical mine infrastructure to impede the spread of fire from a facility fire to the surrounding woodlands and to protect the facilities from a wildfire. The fire water tank (part of the freshwater tank) is designed to accommodate a fire water inventory with at least 500 m^3, equivalent to two hours fire water supply. The tank is automatically replenished with a water level triggered pumping system. The fire water tank is served by a single dedicated pump. The fire water piping network is kept pressurized with a smaller single duty fire water jockey pump. A network of fire hydrants will be located outdoors close to potential site assets. Indoor fire hose cabinets will be located within most buildings. Fire extinguishers will be located indoors at strategic locations. Sprinklers will be installed in office and shop areas, and will include the dry (i.e., change rooms), warehouse and laboratory areas. Automated fire detection and fire protection systems will be installed in various areas.
Attachment:	No

RESPONSE TO IAAC-140

ID:	**IAAC-140**
Expert Department or Group:	IAAC MMF-08
Guideline Reference	2.4 Application of the precautionary approach 6.6.1 Effects of potential accidents or malfunctions 8.0 Follow-up and Monitoring Programs
EIS Reference	22.4.1 Tailings Management Facility Malfunction 22.5.1 Tailings Management Facility Malfunction 22.5.2.3 Environmental Effects Assessment
Information Request:	a. Describe the accident and malfunction scenario (including worst-case scenario) for the uncontrolled seepage of tailings from the TMF, including the potential and risk associated with improper construction, installation, or damage to the TMF liners or other safeguards/features that would contribute to the scenario. i. Describe the risk for adverse effects to VCs where there is potential for long timeframes associated with Project modifications used to address an accident/malfunction and resolution of the accident or malfunction. Provide a worst-case scenario for the malfunction that would not lend itself to a timely resolution. ii. Provide an assessment of the potential risks to other VCs for this accident/malfunction scenario. iii. Describe all steps that would be taken if an accident or malfunction of this nature was to occur and how contingency planning and emergency response would account for the worst plausible situation. b. Describe the follow-up and monitoring plan and the triggers that would initiate an emergency response. Discuss the monitoring that would enable the detection of uncontrolled, unanticipated and/or excess seepage of tailings from the TMF into surrounding groundwater environments in the context of IAAC-104.
Response:	a. The worst-case scenario that would result in the release of uncontrolled seepage would likely be due to a pre-existing defect in the liner at the time of installation that would allow for a preferential pathway for tailings water to report downstream. Seepage rates through the foundation of the dams when the tailings management facility (TMF) is fully constructed to its ultimate height (and highest pond level), with a functioning liner and grouted bedrock foundation is anticipated to be on the order of 10^{-6} m/s. A defect in the liner causing a localized increase in seepage at a particular location would likely exhibit a rate of about 10^{-5} m/s based on the types of internal fill materials in the dam. The fill materials have been designed to be filter-compatible, therefore internal erosion of dam fill material is unlikely. An increase in dam seepage by an order of magnitude should still be able to be handled by the surrounding collection ditches and seepage collections sumps / wells. i. and ii. The worst-case scenario is described in a. above. Some seepage through and under the dams at the TMF can be anticipated. It is expected that most of the seepage from the dams can be collected in ditches and conveyed to small sumps and, if necessary, pumped back into the TMF. Therefore, the potential risk to the valued components (VCs) under this worst-case scenario is anticipated to be low in recognition of contingency planning and the

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implementation of engineering and quality controls during the design, construction, and operational phases to mitigate these risks.

iii. The Emergency Response and Spill Prevention and Contingency Plan (ERSPCP) will facilitate response to emergency situations that could occur at the Project sites. The objective of the ERSPCP is to provide for emergency preparation and response as well as spill prevention and contingency planning in accordance with legislation and guidelines, and corporate policies and procedures, and best practices for the protection of human health and the environment. Measures will be prescribed for the provision of:

  - Emergency response planning (e.g., development and revisions to the ERSPCP, and dialogue with local emergency services).
  - Training (e.g., including but not limited to site orientation, annual refreshers, emergency response drills with mine staff and local emergency response service).
  - Roles and responsibilities (e.g., first on scene at an emergency, and management responsibilities).
  - Step-by-step response protocols (e.g., steps to identify, control, and clean up spills, notification processes for mine staff and local residents during emergency situations, fire suppression protocols).
  - Requirements for clean-up equipment and materials (e.g., spill kits, fire suppression equipment).
  - Contact and reporting procedures (e.g., emergency contacts including Indigenous community members, the town of Lynn Lake, local emergency services, and regulators, as well as requirements for immediate and annual reporting).

The response to IAAC-143 provides further details on the ERSPCP.

b. The monitoring that would enable the detection of uncontrolled, unanticipated and/or excess seepage of tailings from the TMF into surrounding groundwater environments is detailed below:

- Monitoring groundwater levels, using monitoring wells/drive point piezometers.
- Groundwater quality – samples would be analyzed for general chemistry and select dissolved metals and compared with applicable regulatory standards (i.e., GCDWQ, MWQSOG, CWQG-FAL, and the Ontario Ministry of the Environment GW3 criteria).
- Monitoring of surface water quality at receiving waterbodies (general parameters, anions, metals).
- Monitoring of fish and fish habitat based on a “before-after-exposure-control” approach which will entail comparison of physical habitat metrics important to the health of fish and fish habitat measured before the incident (i.e., baseline) to the same metrics measured after the incident (i.e., quantity of littoral habitats, reduction in quantity and quality of stream habitat [based on water depth and velocity] and overwintering habitat in lakes, and changes in water temperature affecting fish growth and survival).
- Monitoring of impacted areas for re-vegetation success through the application of supplementary mitigation measures such as reseeding. Remediated areas

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	will be considered successfully reclaimed when re-vegetation is assessed to be composed of mostly native species that are self-sufficient. In the event that an unexpected deterioration of the environment is observed as part of follow-up and/or monitoring, intervention mechanisms will include the adaptive management process described in Volume 3, Chapter 23, Section 23.2 of the EIS, and within the ERSPCP. This may include an investigation of the cause of the deterioration and identification of existing and/or new mitigation measures to be implemented to address it. Triggers that would initiate adaptive management and/or emergency response and contingency measures may include but are not limited to substantial, rapid, or prolonged changes or trends in monitoring parameters (e.g., changes in groundwater levels, surface water quality). The level of response (i.e., adaptive management vs. emergency response) will depend on the magnitude and speed of the change observed (e.g., large magnitudes rapid changes are more likely to require emergency measures).
Attachment:	No

RESPONSE TO IAAC-141

ID:	**IAAC-141**
Expert Department or Group:	ECCC-37 IAAC MCCN-37 MCCN-38 MCCN-97 MCCN-98
Guideline Reference	2.4 Application of the precautionary approach 4.3 Study strategy and methodology 6.6.1 Effects of potential accidents or malfunctions 6.6.2 Effects of the environment on the project
EIS Reference	9.4.1.2 Project Pathways 21.4.1.2 Potential Effects of Climate and Climate Change on the Project 21.4.1.3 Mitigation 22.4.1 Tailings Management Facility Malfunction 22.5.1 Tailings Management Facility Malfunction Probable maximum precipitation and climate change; Kunkel, Karl, Easterling, Redmond, Young, Yin and Hennon (2013)
Information Request:	a. Provide an assessment of the likelihood of a potential TMF dam breach and the rationale for the estimation. b. Describe how projected climate changes and scenarios (e.g., extreme precipitation events, probable maximum flood, drought) have been or will be considered or accommodated for in Project design of the TMF, the emergency spillway, and contact water collection ditches (see related information request Round 1, Package 1, IAAC-14) for all phases of the Project. i. Include a rationale for the scenarios assessed (i.e., 100 year, 24 hour rainfall event). ii. Describe any additional mitigation measures and/or follow-up, as required. c. Describe the conditions under which the emergency spillway as a component of the TMF facility will be used and describe where the TMF water will be routed to in the event of extreme precipitation/accident and malfunction. d. Provide an assessment of potential effects on VCs and impacts to Indigenous rights and interests resulting from the spilling of excess TMF water in the event of an extreme precipitation event and/or accident and malfunction scenario.
Response:	a. As described in Volume 3, Chapter 22, Section 22.4.1 of the EIS, while the potential consequences associated with a failure of TMF dams during operation were classified as “High” by Golder (2019), the likelihood and overall risks associated with the TMF during construction and operation have been classified as low in recognition of contingency planning and the implementation of engineering and quality controls during the design, construction, and operational phases to mitigate these risks. During operation, Alamos will implement a systematic performance monitoring program, critical to maintaining the physical integrity of the dams and ancillary structures at the TMF. A dam breach assessment (DBA) will be performed during Project detailed design and prior to construction to confirm the consequences of failure. At that time, a risk assessment will be performed to assess the likelihood and consequence of a dam breach as well as the potential modes of failure. A preliminary estimated consequence classification of “High” has been selected because a breach could potentially affect the Keewatin River watershed. The DBA will consider the following breach scenarios/locations: • Breach at west end of TMF toward the Keewatin River.

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- Breach at north end toward Keewatin River via Payne Lake.
- Breach at northeast end, moving southwards toward Minton Lake.

Quantifying the potential effects will be performed during the DBA. The potential consequences to be considered will include:

- The potential population at risk (based on the inundation area).
- The potential loss of life (based on velocity and depth of flow in the inundation areas).
- A qualitative estimate of the environmental impacts based on established knowledge of downstream habitats of rare and endangered species.
- Health, social, cultural, infrastructure and economic impacts. This will be assessed based on the presence of areas of interest, businesses, infrastructure and other community assets within the inundated areas.

The DBA will also include a risk assessment to assess the likelihood of a dam breach as well as the potential modes of failure. Potential modes of failure such as foundation, piping and overtopping failures will be assessed.

b. To date, the Project has considered climate scenarios based on historical records. Conservatism was included by allowing for up to 100-yr wet years in the operating range and for an environmental design flood (EDF) of 100 yrs. Under normal circumstances, the only anticipated discharge is reclaim water back to the mill. Under these circumstances and normal operating conditions, no tailings management facility (TMF) discharge is anticipated. Discharge is anticipated only in the event of the inflow design flood (IDF) occurring just prior to a dam raise, which may activate the emergency spillway. Activation of the emergency spillway under these extreme precipitation events is to prevent overtopping and potential breach of the perimeter dam. Routing the IDF through the spillway is based on the approach adopted by the Canadian Dam Association, Dam Safety Guidelines and the Technical Bulletin on the Application of Dam Safety for Mining dams.

Under the next phase of Project design, effects of climate change will be considered, including extreme precipitation events. This will be in the form of reviewing the critical event duration to be used as EDF (24-hr EDF vs a longer duration rainfall or snowmelt event) as well as reviewing and updating (if necessary) the EDF volume based on climate change predictions.

i. Due to the TMF pond capacity over the life-of-mine, there will be monitoring of pond levels to provide advanced notice of a potential future storage problem (in the order of years). Trigger action response plans (TARPs) and operational guidelines will also be developed as a part of detailed operational plans of the TMF which will detail long- and short-term water management strategies. In the event that treatment and discharge from the TMF is required, the discharge point will be that of the main site collection pond (into the Keewatin River, at the bridge crossing).The 24-hr EDF was selected above the maximum operating water level. Under the next phase of Project design, the critical event duration to be used as EDF (24-hr EDF vs a longer duration rainfall or snowmelt event) will be reviewed. As stated previously, a review will also be done to assess if the EDF volume should be adjusted to consider climate change. This will be in the form of reviewing the critical event duration to be used as EDF (24-hr EDF vs a longer duration rainfall or snowmelt event) as

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	well as reviewing and updating (if necessary) the EDF volume based on climate change predictions. ii. No additional mitigation measures and/or follow-up have been identified. c. The TMF will be equipped with an emergency spillway to allow safe routing of flows from precipitation to prevent dam overtopping. The design flooding event for the operation of the Project was selected as 1/3 between the 1 in 1000-year and the probable maximum flood, according to the criteria outlined in the Canadian Dam Association Dam Safety Guidelines. The design flooding event for the post-closure (passive) phase of the Project was selected as 2/3 between the 1 in 1000-year and the probable maximum flood. In the event that the spillway is activated under these conditions, the spillway will discharge into the Keewatin River watershed through the Keewatin River. Detailed design of the spillway and channel will be completed at the detailed engineering stage. d. As described in part c., the TMF will be equipped with an emergency spillway to allow safe routing of flows from extreme precipitation events to prevent dam overtopping. An assessment of potential effects on Valued Components (VCs) from a TMF failure or uncontrolled release of water and/or tailings into the environment is provided in Volume 3, Chapter 22, Section 22.5.1 of the Environmental Impact Statement (EIS). This assessment represents the worst-case scenario in the event of a TMF dam breach. As noted in this section, in the event of a TMF dam failure, liquid tailings would be released to the environment, affecting the waterways within the Project Development Area (PDA), and the surrounding area. Tailings solids could also be deposited along low-lying areas extending from the breach location, potentially causing localized infilling of vegetated areas and waterbodies. Depending on the timing and extent of a potential failure, effects to surface water, fish and fish habitat, groundwater, vegetation and wetlands, and wildlife habitat, may occur. Effects on these VCs could potentially affect local land and resource use, and archaeological and cultural heritage resources. There is also potential for subsequent residual adverse effects on human health. As described in Volume 3, Chapter 19, Section 19.9.3 of the EIS, the ability to exercise or practice Indigenous or Treaty rights, including harvesting rights and integral practices, traditions, and customs, depends upon the health of the land to support these practices. The potential effects of the Project on asserted or established Indigenous or Treaty rights are derived directly or indirectly from the physical effects of the Project on the environment. Effects to the VCs noted above may also results in effects to the availability of resources currently used for traditional purposes, change in access resources currently used for traditional purposes, change to traditional cultural and spiritual sites or areas, and change to the environment that affects cultural value or importance associated with current use. The is also potential for environmental effects to Indigenous health, through effects to air, water, and soil quality, as well as consumptive resources (country foods), as well as effects to Indigenous socio-economic conditions such as fishing, trapping, and recreation in the surrounding area. These factors could lead to effects on the ability to exercise Indigenous or Treaty rights. As noted in Volume 2, Chapter 16, Section 16.4.1.1, Indigenous Nations engaged on the Project have not identified cultural sites, buildings, or landscapes within the MacLellan site PDA or the Gordon site PDA. Predictive modelling indicates a low potential for the PDA and Rights LAA of the Project sites to contain unknown

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	heritage resources, so effects from a TMF failure are not anticipated for changes to heritage resources. In the event of inadvertently exposed heritage resources, a protection plan is in place to mitigate such exposures. Alamos will develop contingency planning and implement engineering and quality controls during the design, construction, and operational phases to mitigate adverse environmental effects.
Attachment:	No

RESPONSE TO IAAC-142

ID:	**IAAC-142**
Expert Department or Group:	ECCC-39 MCCN-101
Guideline Reference	6.6.1 Effects of potential accidents or malfunctions
EIS Reference	22.5 Effects Assessment of Potential Accidents or Malfunctions
Information Request:	a. For each accident and malfunction scenario, provide specific emergency response measures, capacities, contingencies, and emergency response procedures that are planned. Provide specificity and clarity about how each malfunction or accident will be addressed (i.e., in a step-wise process). b. Provide and describe an emergencies communications plan. i. Define the types of possible events, such as an event deemed significant, an event that is deemed an emergency, and an event that is deemed both significant and an emergency. ii. Describe the means of communication and urgent notification procedures that would be followed in an emergency event. iii. Describe the emergency communication measures that will be in place for Indigenous Nations. iv. Describe how environmental damage will be reported and how follow-up will be conducted regarding accidents and malfunctions, including with Indigenous Nations. v. Outline emergency communication procedures for both urgent immediate actions (such as public notification of safety issues, shelter-in-place and evacuation directions), as well as longer term actions (such as general website and hotlines, incident status updates, injured wildlife reporting, etc.).
Response:	Emergency response measures associated with the accident and malfunction scenarios assessed in the Environmental Impact Statement (EIS) are provided in Volume 3, Chapter 22, Sections 22.5.1.2 (Tailings Management Facility Malfunction), 22.5.2.2 (Release of Untreated Contact Water), 22.5.3.2 (Fuel and Hazardous Materials Spill), 22.5.4.2 (Ore, Overburden, and Mine Rock Storage Area Slope Failure), and 22.5.5.2 (Vehicle Accidents) of the EIS. The Emergency Response and Spill Prevention and Contingency Plan (ERSPCP) will facilitate response to emergency situations that could occur at the Project sites. The objective of the ERSPCP is to provide for emergency preparation and response as well as spill prevention and contingency planning in accordance with legislation and guidelines, and corporate policies and procedures, and best practices for the protection of human health and the environment. Measures will be prescribed for the provision of emergency response planning, training, roles and responsibilities, step-by-step response protocols, requirements for clean-up equipment and materials, and contact and reporting procedures. Elements of the ERSPCP are summarized below.

Tailings Management Facility Failure

In the event of a failure of the Tailings Management Facility (TMF) dam or other containment dams or structures, tailings, waste materials or water could be released to the environment. To respond to a failure of the TMF dam, Alamos will:

- Immediately cease the pumping of tailings and contact water to the TMF and, if needed, lower the reclaim pond by pumping to the open pit.
- Notify applicable regulatory authorities and emergency responders.
- Notify local residents, Indigenous Nations, downstream users in the affected area, and the general public that there has been an incident and advise them not to enter or use affected areas (e.g., forest, creek/riverside, lakeshore) until further notice.
- Use earth-moving equipment to construct temporary berms across drainage channels to capture tailings or waste materials where possible and reduce/eliminate further loss/spread.
- Assess monitoring and remedial requirements and submit a plan to the applicable regulatory authority.
- Investigate the root causes of the failure and develop and implement measures to eliminate further occurrence.

Release of Untreated Contact Water

In the event of a failure of the water collection system resulting in a release of untreated contact water to the environment, Alamos will:

- Pump water back into the collection system and repair the containment structure, if feasible.
- Notify applicable regulatory authorities and emergency responders.
- Notify local residents, Indigenous Nations, downstream users in the affected area, and the general public that there has been an incident and advise them not to enter or use affected areas (e.g., forest, creek/riverside, lakeshore) until further notice.
- Use earth-moving equipment to construct temporary berms across drainage channels to capture untreated contact water or waste materials where possible and reduce/eliminate further loss/spread.
- Assess monitoring and remedial requirements and submit plan to regulatory authority.
- Investigate the root causes of the failure and develop and implement measures to eliminate further occurrence.

Fuel or Hazardous Materials Spill

In the event of a spill near or onto water, the following general response steps/actions will be taken:

- Safety of employees, site personnel and the public will be ensured.
- Spill material source will be identified.
- Necessary equipment and personnel to stop, contain and clean-up the spill and remediate the site will be mobilized.
- If safe to do so:
  - Take measures to stop the flow from the source.

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    - Construct barriers with available materials (e.g., earth berm, trench, or absorbent pads) to prevent the spread of material, in particular to stop the spill from entering a watercourse.
    - Block culverts with plywood, poly, and/or sandbags.
    - Deploy hydrophobic absorbent pads on water surface for a small spill; deploy larger absorbent socks, buoyant curtain, or barriers on larger spills to limit dispersal (weather and water flow conditions permitting) with a pump, or hydrophobic absorbent pads to remove the spilled material from inside the boomed area.
- If the spill occurs on ice and snow, undertake the following (in addition to the above):
    - Take measures to stop the flow from the source.
    - Construct barriers with available materials (e.g., snow or absorbent pads) to prevent the spread of material, in particular to stop the spill from entering a watercourse.
    - Pump, shovel and/or use absorbent pads to collect spilled material if pooling; scrape ice and contain contaminated snow/ice in appropriate sealed containers with lids, or in drums; label and secure in a designated area with secondary containment.

Ore, Overburden, and Mine Rock Storage Area Slope Failure

In the event of the failure in ore, overburden or mine rock stockpiles/storage areas, ore, overburden, or mine rock could be released to the environment. Mine rock slope failure will be monitored as part of the Mine Rock Management Plan. To respond to a failure of the surface stockpiles, Alamos will:

- Immediately cease operations in the affected area.
- Implement measures in response to medical emergencies.
- Notify applicable regulatory authorities and emergency responders.
- Investigate the root cause of the failure and develop and implement measures to reduce the possibility of recurrence.

Vehicle Accidents

On and off-site vehicle accidents associated with the Project could result in emergencies including:

- Spills from a vehicle collision – A vehicle collision involving transports or haul trucks may result in the release of hazardous materials such as mill reagents, fuel, or other non-hazardous materials such as construction materials.
- Fire or explosion associated with a vehicle collision.
- A vehicle collision involving personnel, transports, and haul trucks may result in injuries to personnel or members of the public.

Alamos will work with external responders as needed/requested to provide assistance (personnel and equipment as required) for off-site emergencies. On and off-site vehicle collisions will be reported to Alamos Senior and Management and outside regulatory agencies and other local officials such as the Royal Canadian Mounted Police (RCMP).
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Several traffic safety measures will be implemented to reduce the potential for vehicle-related malfunctions or accidents as a result of the Project. These include, but are not limited to, the following:

- Project vehicles will be driven by trained and competent drivers who will use approved routes.
- Highway laws will be obeyed, including seasonal weight restrictions, speed limits, traffic signage and requirements for permit for oversized loads.
- Project vehicles will be manually inspected daily to confirm there are no problems.
- Mine roads will be properly constructed and maintained.
- Internal speed checks will be carried out by mine security.
- Merging lines will be painted on highway turnoffs to mine sites, in coordination with Manitoba Infrastructure.
- Mine vehicles will be required to have beacon lights and flagging.
- Roads on MacLellan and Gordon sites will be radio controlled.
- Access to the mine sites will not be permitted by public vehicles.
- Implement road safety measures such as speed limits and signage to reduce the chance for wildlife collisions both on-site and between sites.

Alamos will provide emergency response services sufficient in capacity and capability to respond to emergency situations at the mines. Alamos will cooperate with local officials in the incident investigation process and conduct an internal incident investigation. Remedial action will be taken by Alamos in accordance with the results of the investigations.

An Emergency Communication Plan (ECP) will be an integral component of the ERSPCP. The ECP will identify possible event types, means of communication and notification procedures in the event of an emergency, including communication with Indigenous Nations and the pulic, and urgent and longer term communication. The ERSCP will include guidance on reporting and follow up related to accidents and malfunctions, including reporting to Indigenous Nations. The ECP will:

- Define the types of possible events, such as an event deemed significant, an event that is deemed an emergency, and an event that is deemed both significant and an emergency.
- Describe the means of communication and urgent notification procedures that would be followed in an emergency event.
- Describe the emergency communication measures that will be in place for Indigenous Nations.
- Describe how environmental damage will be reported and how follow-up will be conducted regarding accidents and malfunctions, including with Indigenous Nations.

Emergency communication procedures will be outlined for both urgent immediate actions (such as public notification of safety issues, shelter-in-place and evacuation directions), as well as longer term actions (such as general website and hotlines, incident status updates, injured wildlife reporting, etc.).

In the event of an emergency situation that has the potential to affect worker or public safety or has an effect outside of the mine sites (e.g., fire, TMF failure, major spills/explosions), the incident will be reported immediately to emergency site

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	personnel and appropriate external contact resources, including applicable regulatory authorities (e.g., MCC regulators) and external first responders as necessary (e.g., the Town of Lynn Lake Fire Department, the local RCMP detachment, Emergency 911). Depending on the nature and severity of the emergency situation, local residents, Indigenous Nations, downstream users in the affected area, and/or the general public will also be notified that there has been an incident and will be advised not to enter or use affected areas until further notice.
Attachment:	No

RESPONSE TO IAAC-143

ID:	**IAAC-143**
Expert Department or Group:	CCN-131 MCCN-101 MCCN-102 SDFN-152
Guideline Reference	2.4 Application of the precautionary approach 6.6.1 Effects of potential accidents or malfunctions 8.0 Follow-up and Monitoring Programs
EIS Reference	23.5.1 Emergency Response and Spill Prevention and Contingency Plan 23.5.10 Explosives Management Plan 23.5.13 Erosion and Sediment Control Plan
Information Request:	a. Provide details of the Emergency Response and Spill Prevention and Contingency Plan and the Explosives Management Plan, including: i. parameters to be measured, the planned implementation timetable for follow-up studies (if applicable), monitoring methods, and reporting mechanisms; ii. a description of the characteristics of the monitoring program, including location of interventions, planned protocols, schedule, and resources required; and iii. a description of how Indigenous Nations will be involved in the development and implementation of monitoring and follow-up activities. Describe how follow-up and monitoring outcomes will be communicated to Indigenous Nations.
Response:	a. Details on the Emergency Response and Spill Prevention and Contingency Plan and the Explosives Management Plan, including measurable parameters, characteristics of the monitoring programs, and involvement of Indigenous Nations are not yet available as the plans have not been finalized. i. and ii. Preliminary information regarding these plans is provided below. **Emergency Response and Spill Prevention and Contingency Plan** The Emergency Response and Spill Prevention and Contingency Plan (ERSPCP) focuses on prevention and response measures for accident and malfunction scenarios, including emergencies and spills, in unplaned situations, and includes mechanisms for corrective or maintenance actions for less severe events. Specific objectives of the ERSPCP are to: • Identify the organization, responsibilities, and reporting procedures of the Emergency Response and Spill Prevention Team. • Define appropriate communication protocols, including procedures to contact relevant regulatory agencies and Indigenous Nations related to an accident or malfunction event and follow-up actions that will be taken. • Provide site information on the facilities and contigencies in place should an emergency, spill or compliance issue occur. • Provide support and information on available resources, facilities, and trained personnel in the event that an emergency or spill event occurs. Implementation of the ERSPCP is intended to provide Project personnel with the necessary framework and tools to: • Clearly communicate the nature of an emergency or spill incident through appropriate established channels.

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- Prevent the inadverent release of materials which may have a deleterious effect on terrestrial and aquatic environments.
- Organize an appropriate response to emergencies in an efficient manner.
- Respond with appropriate measures to an inadvertent release in a timely manner.
- Report emergencies and/or spill incidents to key Project personnel (i.e., senior management, response officials, staff), Indigenous Nations, regulatory bodies, local authorities, stakeholders, and the public in a timely and appropriate manner.

The ERSPCP will facilitate response to emergency situations that could occur at the Project sites during all Project phases. The objective of the ERSPCP is to provide for emergency preparation and response as well as spill prevention and contingency planning in accordance with legislation and guidelines, and corporate policies and procedures, and best practices for the protection of human health and the environment. As discussed in the response to IAAC-140, measures will be prescribed for the provision of emergency response planning, training, roles and responsibilities, step-by-step response protocols, requirements for clean-up equipment and materials, and contact and reporting procedures.

Monitoring activities and methods and measurable parameters will include:

- Frequent visual and technical inspections of mine infrastructure and equipment to document condition and identify potential hazards or areas of repairs/preventative maintainence in a timely manner.
- As described in Section 22.5.1, Chapter 22, Volume 3 of the EIS, the TMF will also be monitored through an independent review/inspection program, and dam insturmentation.
- Monitoring groundwater levels, using monitoring wells/drive point piezometers.
- Groundwater quality – samples would be analyzed for general chemistry and select dissolved metals and compared with applicable regulatory standards (i.e., GCDWQ, MWQSOG, CWQG-FAL, and the Ontario Ministry of the Environment GW3 criteria).
- Monitoring of surface water quality at receiving waterbodies (general parameters, anions, metals) through sample collection and analysis.
- Monitoring of fish and fish habitat based on a “before-after-exposure-control” approach which will entail comparison of physical habitat metrics important to the health of fish and fish habitat measured before the incident (i.e., baseline) to the same metrics measured after the incident (i.e., quantity of littoral habitats, reduction in quantity and quality of stream habitat [based on water depth and velocity] and overwintering habitat in lakes, and changes in water temperature affecting fish growth and survival).
- Monitoring of impacted areas for re-vegetation success through the application of supplementary mitigation measures such as reseeding. Remediated areas will be considered successfully reclaimed when re-vegetation is assessed to be composed of mostly native species that are self-sufficient.
- Monitoring of fish and fish habitat based on a “before-after-exposure-control” approach which will entail comparison of physical habitat metrics important to the health of fish and fish habitat measured before the incident (i.e., baseline)

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	to the same metrics measured after the incident (e.g. habitat area, wildlife presence). The reporting procedures and scope of follow-up monitoring will be dependant on the natures and severity of the incident. Events that pose a threat to human health or infrastructure, or for which there is a regulatory requirement (e.g. large spill, fire) will be immediately reported to the appropriate regulatory agency, Indigenous Nations, and local residents. Follow-up studies will target valued components that have been, or are likely to be, affected by the event, and the scope, duration, and extent of the monitoring will be determined in consultation/engagement with the appropriate regulatory agencies, Indigenous Nations, and local residents. Alamos will provide emergency response services sufficient in capacity and capability to respond to emergency situations at the mines. This will include first aid equipment (including ambulatory services) and trained medical staff, emergency response vehicles and equipment (e.g., water trucks, excavators), spill kits and spill containment supplies at fuel storage areas and equipped on vehicles. Emergency response equipment for fire and/or explosions is described in Section 22.4.9, Chapter 22, Volume 3 of the EIS and will include a fire water tank with a capacity of 500 m³ equivalent to two hours of fire water supply, a network of fire hydrants, and automated fire detection and protection system. Elements of the ERSPCP are summarized in the following. **Tailings Management Facility Failure** In the event of a failure of the Tailings Management Facility (TMF) dam or other containment dams or structures, tailings, waste materials or water could be released to the environment. To respond to a failure of the TMF dam, Alamos will: • Immediately cease the pumping of tailings and contact water to the TMF and, if needed, lower the reclaim pond by pumping to the open pit. • Notify applicable regulatory authorities and emergency responders. • Notify local residents, Indigenous Nations, downstream users in the affected area, and the general public that there has been an incident and advise them not to enter or use affected areas (e.g., forest, creek/riverside, lakeshore) until further notice. • Use earth-moving equipment to construct temporary berms across drainage channels to capture tailings or waste materials where possible and reduce/eliminate further loss/spread. • If water quality is compromised as a result of the incident, provide an alternate water supply until water quality is restored. • Assess monitoring and remedial requirements and submit plan to the applicable regulatory authority. • Investigate the root causes of the failure and develop and implement measures to eliminate further occurrence. • Visually inspect the tailings management facility daily on a year-round basis. • Implement the follow-up and monitoring activities described in this Plan, as applicable.

Release of Untreated Contact Water

In the event of a failure of the water collection system resulting in a release of untreated contact water to the environment, Alamos will:

- Pump water back into the collection system and repair the containment structure, if feasible.
- Notify applicable regulatory authorities and emergency responders.
- Notify local residents, Indigenous Nations, downstream users in the affected area, and the general public that there has been an incident and advise them not to enter or use affected areas (e.g., forest, creek/riverside, lakeshore) until further notice.
- Use earth-moving equipment to construct temporary berms across drainage channels to capture untreated contact water or waste materials where possible and reduce/eliminate further loss/spread.
- Deploy silt fencing and silt curtains if the material has entered watercourses.
- If water quality is compromised as a result of the incident, provide an alternate water supply until water quality is restored.
- Assess monitoring and remedial requirements and submit plan to regulatory authority.
- Investigate the root causes of the failure and develop and implement measures to eliminate further occurrence.
- Monitor the contact water collection system daily and monthly (depending on season and weather conditions) on a year-round basis.

Fuel or Hazardous Materials Spill

In the event of a spill near or onto water, the following general response steps/actions will be taken:

- Safety of employees, site personnel and the public will be ensured.
- Spill material source will be identified.
- Necessary equipment and crews to stop, contain and clean-up the spill and remediate the site will be mobilized.
- If safe to do so:
  - Take measures to stop the flow from the source.
  - Construct barriers with available materials (e.g., earth berm, trench, or absorbent pads) to prevent the spread of material, in particular to stop the spill from entering a watercourse.
  - Block culverts with plywood, poly, and/or sandbags.
  - Deploy hydrophobic absorbent pads on water surface for a small spill; deploy larger absorbent socks, buoyant curtain, or barriers on larger spills to limit dispersal (weather and water flow conditions permitting) with a pump, or hydrophobic absorbent pads to remove the spilled material from inside the boomed area.
- If the spill occurs on ice and snow, undertake the following (in addition to the above):
  - Take measures to stop the flow from the source.

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- Construct barriers with available materials (e.g., snow or absorbent pads) to prevent the spread of material, in particular to stop the spill from entering a watercourse.
- Pump, shovel and/or use absorbent pads to collect spilled material if pooling; scrape ice and contain contaminated snow/ice in appropriate sealed containers with lids, or in drums; label and secure in a designated area with secondary containment.

Ore, Overburden, and Mine Rock Storage Area Slope Failure

In the event of the failure in ore, overburden or mine rock stockpiles/storage areas, ore, overburden, or mine rock could be released to the environment. Mine rock slope failure will be monitored as part of the Mine Rock Management Plan. To respond to a failure of the surface stockpiles, Alamos will:

- Immediately cease operations in the affected area.
- Implement measures in response to medical emergencies.
- Notify applicable regulatory authorities and emergency responders.
- Investigate the root cause of the failure and develop and implement measures to reduce the possibility of recurrence.

Vehicle Accidents

On and off-site vehicle accidents associated with the Project could result in emergencies including:

- Spills from a vehicle collision – A vehicle collision involving transports or haul trucks may result in the release of hazardous materials such as mill reagents, fuel, or other non-hazardous materials such as construction materials.
- Fire or explosion associated with a vehicle collision.
- Injuries resulting from a vehicle collision – A vehicle collision involving personnel, transports, and haul trucks may result in injuries to personnel or members of the public.

Alamos will work with external responders as needed/requested to provide assistance (personnel and equipment as required) for off-site emergencies. On and off-site vehicle accidents will be reported to Alamos Senior and Management and outside regulatory agencies and other local officials such as the Royal Canadian Mounted Police (RCMP).

Several traffic safety measures will be implemented to reduce the potential for vehicle-related malfunctions or accidents as a result of the Project. These include, but are not limited to, the following:

- Project vehicles will be driven by trained and competent drivers who will use approved routes.
- Highway laws will be obeyed, including seasonal weight restrictions, speed limits, traffic signage and requirements for permit for oversized loads.
- Project vehicles will be manually inspected daily to confirm there are no problems.
- Mine roads will be properly constructed and maintained.
- Internal speed checks will be carried out by mine security.
- Merging lines will be painted on highway turnoffs to mine sites, in coordination with Manitoba Infrastructure.

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- Mine vehicles will be required to have beacon lights and flagging.
- Roads on MacLellan and Gordon sites will be radio controlled.
- Access to the mine sites will not be permitted by public vehicles.
- Implement road safety measures such as speed limits and signage to reduce the chance for wildlife collisions both on-site and between sites.

Alamos will cooperate with local officials in the incident investigation process and conduct an internal incident investigation. Remedial action will be taken by Alamos in accordance with the results of the investigations.

An Emergency Communication Plan (ECP) will be an integral component of the ERSPCP. The ECP will identify possible event types, means of communication and notification procedures in the event of an emergency, including communication with Indigenous Nations, and urgent and longer term communication. The ERSCP will include guidance on reporting and follow up related to accidents and malfunctions, including reporting to Indigenous Nations. The ECP will:

- Define the types of possible events, such as an event deemed significant, an event that is deemed an emergency, and an event that is deemed both significant and an emergency.
- Describe the means of communication and urgent notification procedures that would be followed in an emergency event.
- Describe the emergency communication measures that will be in place for Indigenous Nations.
- Describe how environmental damage will be reported and how follow-up will be conducted regarding accidents and malfunctions, including with Indigenous Nations.

Emergency communication procedures will be outlined for both urgent immediate actions (such as public notification of safety issues, shelter-in-place and evacuation directions), as well as longer term actions (such as general website and hotlines, incident status updates, injured wildlife reporting, etc.).

In the event of an emergency situation that has the potential to affect worker or public safety or has an effect outside of the mine sites (e.g., fire, TMF failure, major spills/explosions), the incident will be reported immediately to emergency site personnel and appropriate external contact resources, including applicable regulatory authorities (e.g., MCC regulators) and external first responders as necessary (e.g., the Town of Lynn Lake Fire Department, the local RCMP detachment, Emergency 911). Depending on the nature and severity of the emergency situation, local residents, Indigenous Nations, downstream users in the affected area, and/or the general public will also be notified that there has been an incident and will be advised not to enter or use affected areas until further notice.

Explosives Management Plan

The objective of the Explosives Management Plan is to reduce the risk of property damage or injury to persons or wildlife on-site or adjacent to the Project sites. A Workplace Hazardous Materials Information System will be in place for the life of the Project that will document the types of blasting materials utilized and levels of blasting activities in addition to this Plan. An inspection procedure will be maintained to confirm the effectiveness of explosives manufacturing and storage, including an inventory of explosives, as well as their handling, transportation, and

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application, that facilitates continuous compliance with established safety protocols at the Project sites.

Monitoring activities will include:

- A Vibration Monitoring Program to be implemented for Gordon at receptor IDs 73 and 76 to measure the vibration air overpressure level during a blast event. Reduced blast charge may be increased if monitoring results indicate air overpressure level below the recommended targets. In the events that the measured values exceed the recommended targets, corrective actions including additional mitigation (e.g., further reduction of blast charge) will be considered.
- A Vibration Monitoring Program to be implemented at the permanent work camp at MacLellan to measure the vibration air overpressure level during a blast event. Reduced blast charge may be increased if monitoring results indicate air overpressure level below the recommended targets. In the events that the measured values exceed the recommended targets, corrective actions including additional mitigation (e.g., further reduction of blast charge) will be considered.

Alamos will work with Indigenous Nations in the design and implementation of Project follow-up and monitoring programs, including evaluation of program results and subsequent updates to the program.

iii. As described in Volume 3, Chapter 23 of the EIS, Alamos will engage with Indigenous Nations regarding the design and implementation of Project follow-up and monitoring programs, including evaluation of program results, and subsequent updates to the program. Alamos will discuss planned monitoring activities with directly-affected Indigenous Nations and provide opportunities for Indigenous Nations to participate in these follow-up and monitoring programs. In the past, for example, five Elders of Marcel Colomb First Nation formed a co-committee with Alamos for environmental monitoring of activities associated with the exploration program deemed to be of high impact (i.e., scout drilling and excavation trenching). In 2020, Marcel Colomb First Nation selected youth representatives to participate in the environmental monitoring activities. This committee or a similar committee could be engaged for follow up and monitoring of the Project. Information on conceptual monitoring and management plans was provided to Indigenous Nations on April 21 (registered mail) and April 22 (email), 2021. Alamos has not received any comments from Indigenous Nations regarding this material to date.

As described in Volume 3, Chapter 23, Section 23.3 of the EIS, as results become available from the follow-up and monitoring program, they will be shared with Indigenous Nations, in a fashion, frequency, and format determined to be appropriate to the applicable audience. A communication mechanism for providing data will be established to distribute information and accept inquiries from Indigenous Nations. Alamos currently maintains a local office/presence in Lynn Lake that facilitates ongoing communications. During operation, Alamos will maintain an office at the MacLellan site and will consider maintaining a smaller office in Lynn Lake during Project operation to further facilitate communication.

Attachment:	No

RESPONSE TO IAAC-144

ID:	**IAAC-144**
Expert Department or Group:	ECCC-38 Conformity Review ECCC-11
Guideline Reference	1.4 Regulatory framework and the role of government 6.6.1 Effects of potential accidents or malfunctions 8.0 Follow-Up and Monitoring Programs
EIS Reference	1.4.2 Other Environmental Regulatory Requirements Table 1-5 2.2.1 Design Standards and Codes 2.7.3 Operation 22.4.3 Ore Milling and Processing Plant Accident or Malfunction 22.4.5 Fuel and Hazardous Materials Spill 22.5.3.3 Environmental Effects Assessment
Information Request:	a. Provide the fate and behavior modelling of potential spills of hydrocarbons, sodium cyanide, and ammonium nitrate to fish-bearing waterways across all seasons. b. Describe the worst-case scenarios for sodium cyanide and ammonium nitrate spills in a similar level of detail and format as was provided for spill of petroleum hydrocarbons in the EIS. c. Provide the Cyanide Management Plan, Ammonium Nitrate Management Plan, and Fuel Management Plan which aim to prevent/minimize any release, discharge or spill to the environment, including applicable mitigation and management measures, principles, and standards of practice. i. Include information on manufacturing, mixing, transportation, handling, storage, use, emergency spill response measures, environmental monitoring, and facility decommissioning. ii. Describe how the effectiveness of the mitigation measures will be monitored and will incorporate appropriate water quality monitoring.
Response:	a. The draft report for fate and behavior modelling for potential spills of hydrocarbons, sodium cyanide and ammonium nitrate is provided in Appendix A. A two-dimensional (2D) hydrodynamic model was built using MIKE 21 Flow Model Flexible Mesh (FM). MIKE 21-monitored data within the lakes is used to estimate low, average, and high water levels in the lakes. Available regional hydrology assessment and regressions is used to estimate flows in the rivers. MIKE 21 Particle Tracking (PT), which is an add on to the MIKE 21 FM, is used to model diesel, sodium cyanide and ammonium nitrate spills. The MIKE 21 PT module is used for modelling of transport and fate of dissolved, suspended and sedimented substances discharged or accidently spilled in rivers and lakes. A point source is added at the location of the bridge crossings in the Hughes River and Keewatin River where an accidental spill may occur. Estimated flux and concentration of the accidental diesel, sodium cyanide and ammonium nitrate spills is assigned to the point source. The model used the worst-case scenarios as described below in part b. The model output will be the fate and behaviour and spatial variations of diesel, sodium cyanide and ammonium nitrate concentrations in the lake over time. Metal and Diamond Mining Effluent Regulations (MDMER) are used as a guide to set the toxicity thresholds and Canadian Water Quality Guidelines – Freshwater Aquatic Life (CWQG-FAL) provides science-based goals for the quality of aquatic life and terrestrial ecosystems.

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This approach was recently used for the completion of a fate and behaviour model for other recent gold mine projects. Spill modelling of diesel fuel, sodium cyanide and ammonium nitrate was conducted to assess the worst-case scenario. The modelling results showed that the MDMER limits representing toxicity thresholds were exceeded for ammonia, but this was not persistent and ranged from one to seven days under the different modelling scenarios (Marathon Gold Corp. 2020). CWQG-FAL limits representing the water quality thresholds were also exceeded for ammonia and cyanide, however, the exceedance was not persistent, and the ammonia concentration reached below the CWQG-FAL limits from one to five days. Cyanide, ammonia, and nitrate are not expected to persist in the environment, or to result in bioaccumulation. Diesel may attach to nearshore and shoreline vegetation and shallow sediments and thus the potential exists for increased persistence of diesel in the environment (Marathon Gold Corp. 2020).

It was conservatively anticipated in the assessment of environmental effects from a fuel or hazardous material spill (Volume 3, Chapter 22, Section 22.5.3 of the EIS) that there is potential for a moderate to high magnitude effect on surface water and fish and fish habitat as a result of localized change in surface water quality and changes in fish health, growth, or survival. As described in Volume 3, Chapter 22, Section 22.5.3.1 of the EIS, waste oils, fuels, and hazardous wastes will be safely handled and transported as recommended by the suppliers and/or manufacturers and in compliance with applicable federal, provincial, or municipal regulations (e.g., the Hazardous Waste Regulation under the *Dangerous Goods Handling and Transportation Act* of Manitoba, *Canadian Environmental Protection Act* and associated regulations, and the *Transportation of Dangerous Goods Act* and associated regulations). As described in more detail on part c. below, a draft Emergency Response and Spill Prevention and Contingency Plan (ERSPCP) for the construction, operation, and decommissioning/closure phases of the Project is in preparation. Measures will be prescribed for the provision of emergency response planning, training, responsibilities, cleanup equipment, and materials, and contact and reporting procedures.

b. Sodium cyanide transport will be in accordance with the International Cyanide Management Code. Sodium cyanide will be transported in briquette form in 18-tonne isotainers to the processing plant at the MacLellan site. Approximately 82 tonnes will be consumed per month, requiring approximately 1 tanker delivery every 2-3 days (total of 7-8 tankers/month). Ammonium Nitrate is the primary component of Ammonium Nitrate Fuel Oil (ANFO) and ammonium nitrate emulsion explosives with the latter considered the primary explosive used at the mine site. The ammonium nitrate will be shipped in prill/flaked (solid) form, in 1,000 kg bags in shipping containers. The ammonium nitrate and fuel oil emulsion will be manufactured at the MacLellan site. The reasonable worst case considered is a spill of sodium cyanide from a 20 tonne delivery truck and ammonium nitrate from an intermodal shipping container.The reasonable worst case for a hazardous material spill would likely be a spill into the Keewatin River at the MacLellan site and a spill into the Hughes River watershed at the Gordon site. It is expected that the the winter and summer low flows will result in the worst case scenario.

The US Department of Transportation's (US DOT) Pipeline and Hazardous Material Safety administration maintains incident records of hazardous material releases in the United States. The records include releases from sites and during a wide range of transportation modes such as railway, maritime shipping and highway transport. The US DOT reported 18,834 highway spills incidents over the

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last 11 years from 01/01/ 2010 and 31/12/2020. Canadian spill incident statistics are difficult to obtain and not publicly available. Canadian spill databases are typically maintained by the provinces and only made available through freedom of information requests. To estimate the spill volumes for the Project at the identified spill locations, the US DOT highway spill record for the 11 years covering 2010 to 2020 was accessed for further analysis.

Of the US DOT reported 18,834 highway spills incidents, 52 were recorded as ammonium nitrate spills (0.28% of all spills), of which two (2) spills were reported to have entered either a waterway or sewer. When the US DOT database was filtered for spills where solid material was shipped in sub-containerization (i.e. bags, drums or IBC-intermediate bulk containers) the material was packaged in sub-containers ranging from 50 - 2000 lbs (22.7 – 909 kg). The average spilled weight was 118 lbs (54 kg) up to three (3) sub-container volumes released (i.e., 3-50 lb bags) although on most cases a single sub-container was breached. When sub-containerized, the spilled weight ranged from 0.5% - 45% of the total shipped weight. The maximum solid form, sub-containerized ammonium nitrate release was 250 lbs (113.6 kg). Review of the US DOT spills database indicates that when sub-containerized, ammonium nitrate releases volumes are small relative to total shipping capacity and the released volumes are typically a single sub-container. Of the >18,000 roadway, in-transit spills in the last decade recorded by the US DOT, there was only one spill of ammonium nitrate emulsion and it was 100 lbs (45.5 kg). Thus, based on review of the US DOT spills database simulating an ammonium nitrate release mass of 45.5 kg is a conservative, credible and realistic representation of a worst-case release.

Just two sodium cyanide releases were reported in the highway spillage category of the US DOT database. Of these, one release was of 100 lbs (45.5 kg) from a 1000 kgs IBC and the other was a release of 1 lbs (0.45 kgs) from a 3000 lbs (1,364 kg) shipment. In neither case was environmental damage or release to a waterbody or sewer reported. Sodium cyanide is commonly shipped in briquette form making it very stable and reducing susceptibility to spill. Therefore, the worst case accidental release of mass of sodium cyanide is assessed as 50 kg (110 lbs).

The total annual emlusion used in explosives is 93,618,997 kg. The total ammonium nitrate used in emulsion is 77,703,768 kg and total fuel used in emulsion is 7,302,282 l.

c. A Emergency Response and Spill Prevention and Contingency Plan (ERSPCP) for the construction, operation, and decommissioning/closure phases of the Project will be finalized during the permitting stage of Project planning (i.e., following receipt of a federal Decision Statement for the Project under CEAA 2012 and provincial licences for the Project under *The Environment Act* of Manitoba) and will be completed prior to the start of Project construction. The objective of the plan is to provide for emergency preparation and response and spill prevention and contingency planning in accordance with federal and provincial legislation and guidelines, and corporate policies and procedures for the protection of human health and the environment. The ERSPCP focuses on response measures for accidents and malfunction scenarios during construction, operation, and decomissioning/closure, including emergencies and spills, in unplanned situations, and includes mechanisms for corrective or maintenance actions for less severe events. The three priorities of the ERSPCP are: protection of life; protection of the environment; and protection of property. The scope of the plan includes spills and

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	the releases of hazardous substances, as well as standard operating procedures for the management of cyanide, ammonium nitrate and fuel. The ERSPCP will help to mitigate the effects of accidents or malfunctions should they occur. Emergency response measures and capacities will be further developed during detailed Project design. Emergency response measures are prepared in accordance with federal and provincial legislation and guidelines, and corporate policies and procedures for the protection of human health and the environment (including species at risk). Measures are prescribed for the provision of emergency response planning, training, responsibilities, cleanup equipment, and materials, and contact and reporting procedures. The preferred method to address spills is by avoidance through appropriate storage, handling, and transportation measures. All spills are reported in the Initial Environmental Incident Report, which will include details of the incident, person notifying, regulator notification for external reporting, and other comments including follow-up actions required. i. Information on manufacturing, mixing, transportation, handling, storage, use, emergency spill response measures, environmental monitoring, and facility decommissioning will be developed based on the final design details and industry best practices, including the International Cyanide Management Code, and will be incorporated in the management plans. Waste oils, fuels, and hazardous wastes (if any) will be safely handled and transported as recommended by the suppliers and/or manufacturers and in compliance with applicable federal, provincial, or municipal regulations. Generally, for cyanide, ammonium nitrate and fuel, the following standard operating procedures will apply: • Alamos will incorporate measures in the design, construction, and operation of its facilities at the MacLellan site to prevent cyanide releases to the natural environment and workplace exposures. The unloading, storage, mixing, and use of cyanide in the gold extraction process will be conducted within contained areas of the processing plant. Cyanide management will be conducted in accordance with the requirements of the International Cyanide Management Code (2016). In the event of a spill, the individual who discovers a serious incident will call out a “CODE 1” on the radio, stating name, location and nature of assistance required. The Health and Safety Coordinator will respond to the call and will be responsible for coordinating the initial response, mobilizing the Emergency Response Spill Prevention Team, and summoning any specialized resources required. • Ammonium nitrate will be kept sealed and dry as it is water soluble. Ammonium nitrate will be kept away from heat and sources of ignition and stored in a cool, well-ventilated areas separate from acids, alkalies, reducing agents and combustibles. Explosives will be managed in accordance with federal and provincial regulations and DFO’s Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters (1998). Any spills are to be managed with the clean-up of the solid ANFO (as per the Spill Prevention and Contingency Section of the Plan). • Standards for petroleum storage and handling are specified as per the Storage and Handling of Petroleum Products and Allied Petroleum Products Regulation MR 188/2001 under *The Dangerous Goods Handling and Transportation Act*. Inspection and maintenance requirements are stipulated for storage tank systems (i.e., aboveground tanks 5,000 L or

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	greater, and/or underground tanks) in accordance with Part 5 of Manitoba Regulation MR 188/2001 Storage and Handling of Petroleum Products and Allied Petroleum Products Regulation and Part 8 of the Canadian Council of Ministers of the Environment (CCME) Code of Practice (2003). A person who is responsible for or who has custody and control of containment involved in an environmental accident will immediately report the occurrence by calling (204) 945-4888. In the event that a leak is discovered, Manitoba Conservation and Climate (MCC) must be notified immediately, in accordance with Section 38, Part 7 of the Petroleum Storage Regulation and Part 8, Section 8.3 Inventory Control, specifically 8.3.4.(1) and 8.3.4.(2) of the CCME Code of Practice (2003). ii. As outlined in Volume 3, Chapter 22, Section 22.5.3.1 of the EIS, an accidental spill will be mitigated through Project design as well as several safety measures. Monitoring is the continuation of observation, measurement, or assessment of environmental conditions at and surrounding the Project, its components or activities. Monitoring plans will describe sampling procedures, quality control and assurance programs, laboratory methods and protocols, laboratory accreditations, and reporting requirements, where applicable. Monitoring, including water quality monitoring, will be carried out on select valued components (VCs) using environmental indicators and measurable parameters identified in the EIS. Components to be monitored will be determined based on regulatory instrument requirements as per legislation (e.g., MDMER, Species at Risk scientific permit), environmental importance, sensitivity and vulnerability, and license requirements. Results from monitoring will be applied to the adaptive management process to adjust mitigation measures and to modify plans on an ongoing basis, if required. Monitoring of spill prevention and contingency planning will be undertaken via routine visual inspections of the various systems, utilizing best management practices to protect the environment and to determine whether new strategies are required. The inspections will be the responsibility of the Environmental Site Manager (or designate). Should a spill occur, either on land or water, follow up monitoring will be instituted, and could include soil or water quality tests to be undertaken at the point of the spill near the ground area, and downstream of the point of entry in the case of a waterbody. In addition, a water quality sample could be collected upstream of the point of entry to demonstrate whether, or not, there has been a water quality effect. Follow up monitoring could also include the implementation of a groundwater monitoring program to document environment conditions related to a spill. Adaptive management is a planned process for responding to uncertainty or to an unanticipated or underestimated Project effect. Information learned from monitoring actual Project effects is applied and compared to predicted effects. Where a variance between the actual and predicted effects occurs, a determination is made as to whether modifications or other actions are necessary to revise the existing mitigation measures. Results from monitoring will be used through an adaptive management process to adjust mitigation measures and to modify plans on an ongoing basis, if required. In the event that an unexpected deterioration of the environment is observed as part of follow-up and/or monitoring, intervention

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	mechanisms will include the adaptive management process described in Chapter 23, Section 23.2 of the EIS. This may include an investigation of the cause of the deterioration and identification of existing and/or new mitigation measures to be implemented to address it. Alamos is committed to continuous improvement and will implement preventative operation and maintenance procedures to reduce the risk of spills, including regular inspection of equipment and hazardous material containment areas and training in proper handling and storage procedures for hazardous materials. **References:** Canadian Council of Ministers of the Environment (CCME). 2003. Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products. International Cyanide Management Institute. 2016. International Cyanide Management Code. Washington, DC. Marathon Gold Corp. 2020. Valentine Gold Project: Environmental Impact Statement. Prepared by Stantec Consulting Ltd. Available at: https://iaac-aeic.gc.ca/050/evaluations/document/136521.
Attachment:	Appendix A, Attachment IAAC-144

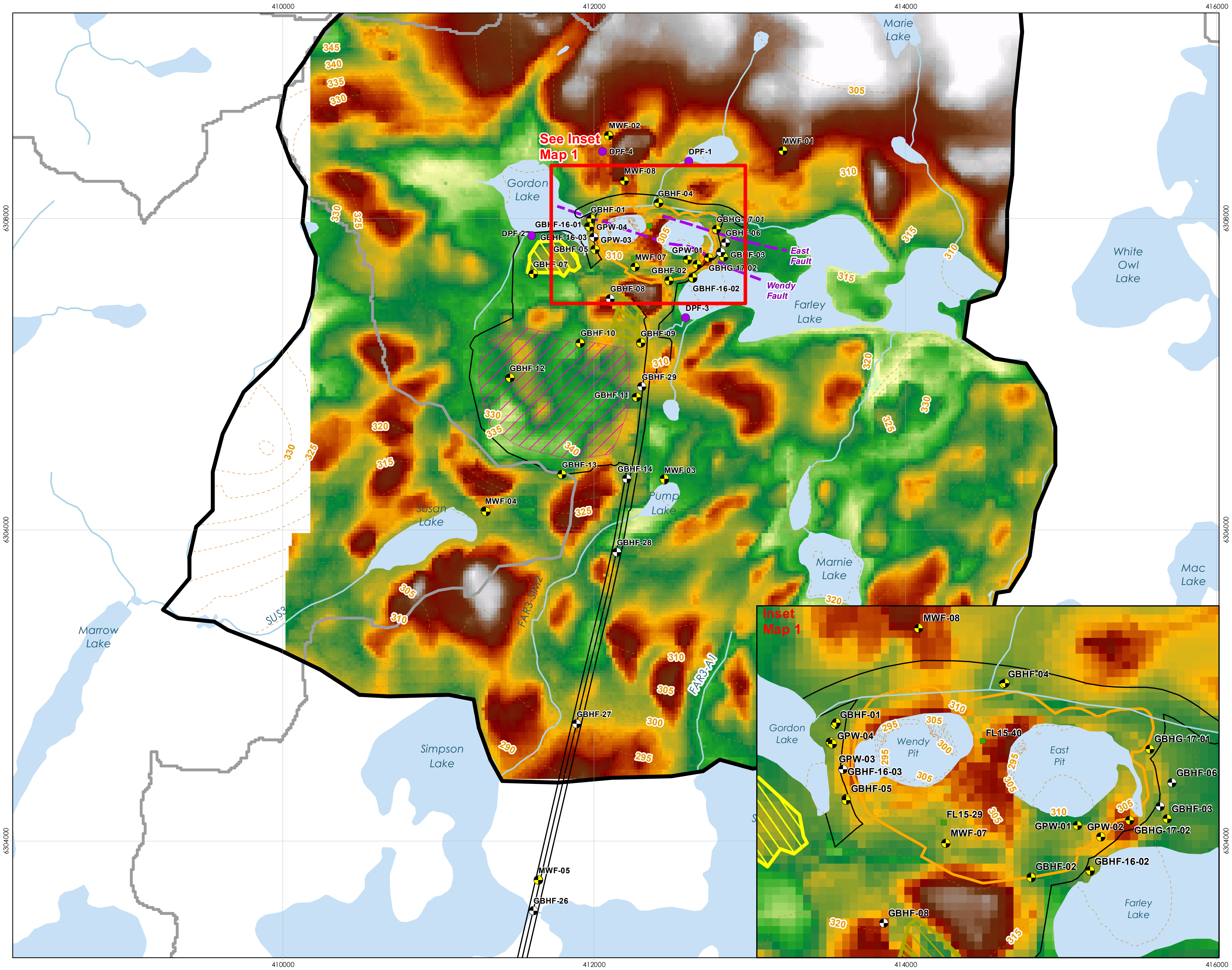
RESPONSE TO IAAC-145

ID:	**IAAC-145**
Expert Department or Group:	MMF-14
Guideline Reference	6.6.2 Effects of the environment on the project
EIS Reference	21.4 Assessment of the Effects of the Environment on the Project
Information Request:	a. Provide a flood modelling study for the Keewatin River in proximity to the Project site to verify the flood risk on site. If a flood modelling study cannot be completed, provide a rationale and an evaluation of the risks of flooding on the Keewatin River water quality. i. The flood modelling study or evaluation of the risks of flooding on the Keewatin River needs to consider effects from rapid pit dewatering to prepare for flooding or after flooding occurs, and indicate where input from Indigenous Nations, including traditional knowledge regarding historic flooding in the area, was incorporated. ii. If the flood modelling indicates that the Project site is at a higher risk of flooding than is noted by the EIS, assess the impacts, determine if the conclusions change, and provide additional mitigation measures to reduce the risk of flooding to Project infrastructure and the risk to water quality in the Keewatin river as needed.
Response:	a. In relation to a flood modelling study for the Keewatin River: i. A draft flood modelling assessment was completed to inform preliminary engineering design decisions and contraints regarding mine infrastructure. Design flows for the Keewatin River were developed based on regional flood frequency analysis using the available regional Water Survey of Canada hydrometric stations. The data was used to generate the 25- and 100-year return period flow events at a location in the Keewatin River adjacent to the proposed location of the pit. A HEC-RAS hydraulic model was then set up to determine the water surface elevation associated with the design flow events. Hydraulic modelling of the Keewatin River near the location of the proposed pit indicated that water level elevation changes are not sensitive to changes in flows due to the channel's capacity to carry these flows at this location. Based on the the modelling results, there is not a connection with flooding in the Keewatin River and the pit; thus there would be no requirement for pit dewatering with respect to flow levels in the Keewatin River. As this preliminary modelling did not indicate a risk from flooding, it was not included in the EIS. A copy of the draft memo is appended to this information request (Appendix A). There will be opportunity during the detailed design phase to obtain additional information regarding traditional knowledge on historical flooding in the area. However, it should be noted that information regarding traditional knowledge will not result in design changes as the flood frequency analysis and hydraulic modelling previously conducted is sufficient for engineering design purposes. ii. The modelling conducted on the Keewatin River was used to inform design and reduce potential flood risk to the Project. No additional mitigation

ID:	**IAAC-145**
	measures to reduce the risk of flooding on Project infrastructure and risk to water quality in the Keewatin River are required. Thus no new mitigation measures are proposed.
Attachment:	Appendix A, Attachment IAAC-145

Appendix A ATTACHMENTS

A.1 ATTACHMENT IAAC-61



Stantec

Project Infrastructure

- 🟧 Proposed Open Pit
- ▨ Potential Ore Stockpile
- ▨ Potential Mine Rock Storage Area
- ▨ Potential Overburden Stockpile
- ☐ Project Development Area

Study Area

- ☐ Groundwater Local Assessment Area (LAA) and Regional Assessment Area (RAA)
- ☐ Subwatersheds

Survey Locations

- ● Borehole
- ● Drive-Point Piezometers
- ● Monitoring Well
- ■ Exploration Borehole
- ---- Top of Bedrock Contour (m)

Landbase

- — Existing Access Road
- - - Fault Zone
- — Watercourse
- 🟦 Waterbody

Overburden Thickness (m)
High : 43.8
Low : 0

0 250 500 Metres
(At original document size of 11x17)
1:25,000

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada.

Project Location
Lynn Lake,
Manitoba

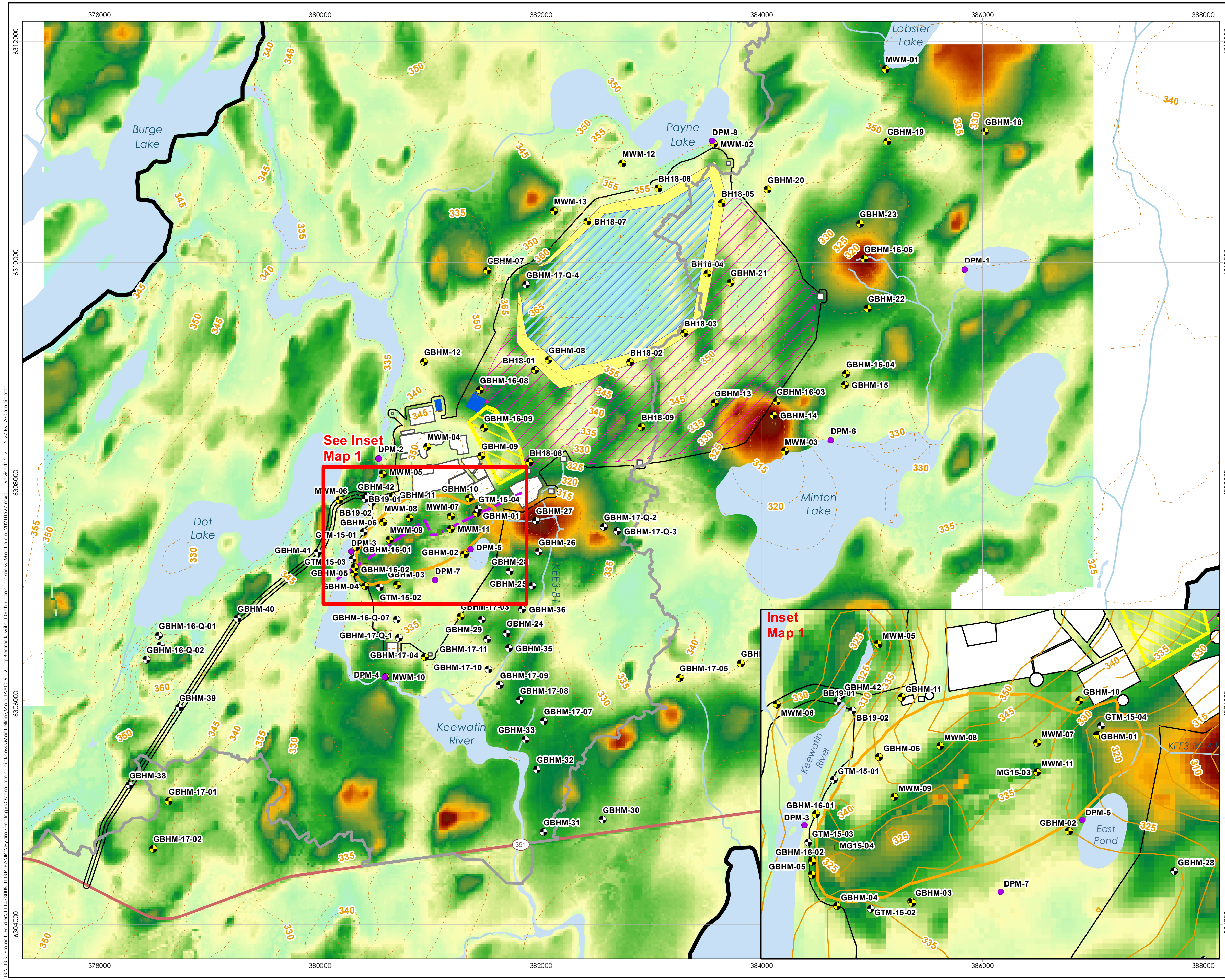
Prepared by ACampigotto on 2021-01-25
Technical Review by MFraser on 2021-01-25

Client/Project
111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-61-1

Title
Overburden Thickness - Gordon

G:_GIS_Project_Folder\111473008_LLGP_EA\IRs\Hydro-Geology\OverburdenThickness\Gordon\Map_IAAC-61-1_TopBedrock_with_OvebrurdenThickness_Gordon_20210125.mxd Revised: 2021-01-25 By: ACampigotto



Stantec

Project Infrastructure

- 🟧 Proposed Open Pit
- ▨ Proposed Mine Rock Stockpile
- ▨ Proposed Overburden Stockpile
- 🟨 Proposed Tailings Management Facility
- ▨ Proposed Tailings Management Facility Pond
- 🟦 Other Proposed Ponds
- ☐ Other Proposed Areas
- ☐ Project Development Area

Study Area

- ☐ Groundwater Local Assessment Area (LAA) and Regional Assessment Area (RAA)
- ☐ Subwatersheds

Survey Locations

- ◐ Borehole
- ● Drive-Point Piezometers
- ◐ Monitoring Well
- ■ Exploration Borehole
- - - - Top of Bedrock Contour (m)

Landbase

- — Existing Access Road
- — Highway
- - - Approximate Location of NSZ
- — Watercourse
- ■ Waterbody

Overburden Thickness (m)
High : 55.4
Low : 0

N

0 0.5 1 Kilometres
(At original document size of 11x17)
1:35,000

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada.

Project Location
Lynn Lake,
Manitoba

Prepared by ACampigotto on 2021-05-27
Technical Review by MFraser on 2021-05-27

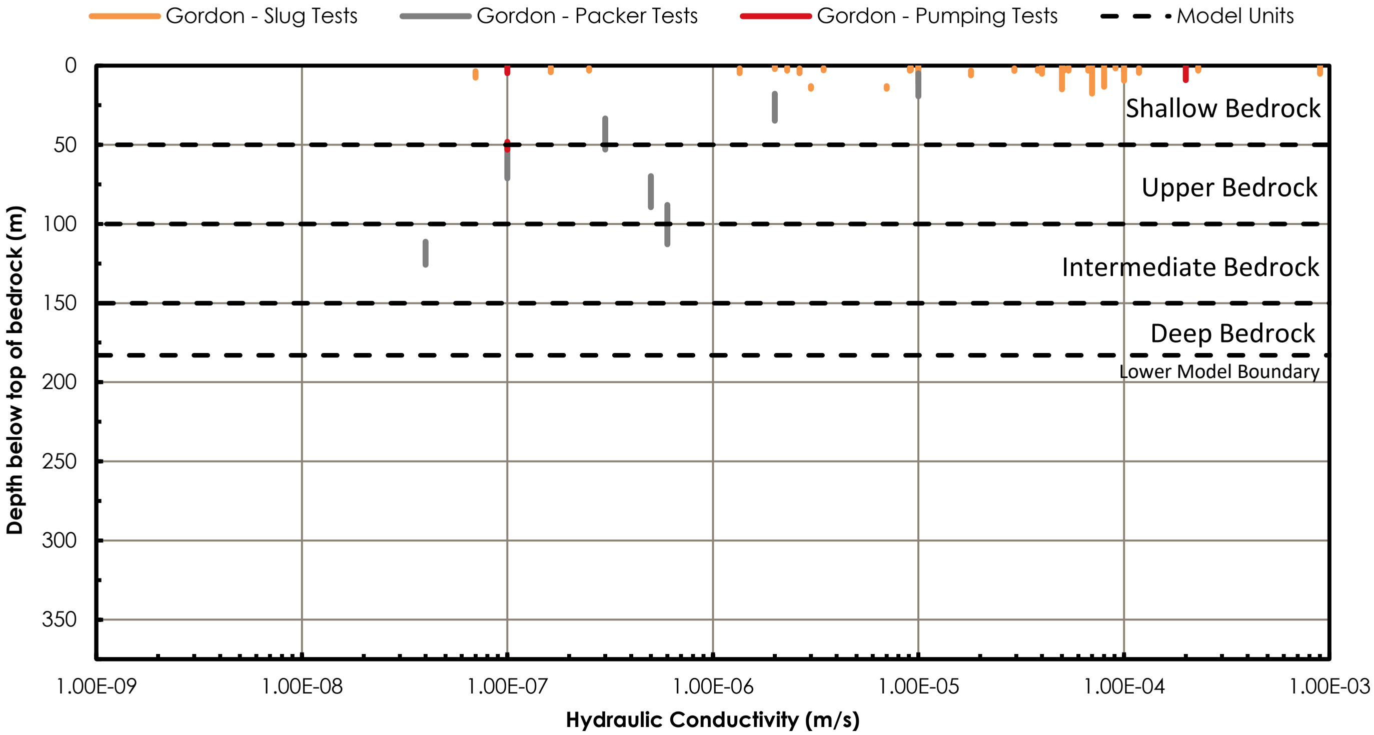
Client/Project
ALAMOS GOLD INC.
Lynn Lake Gold Project

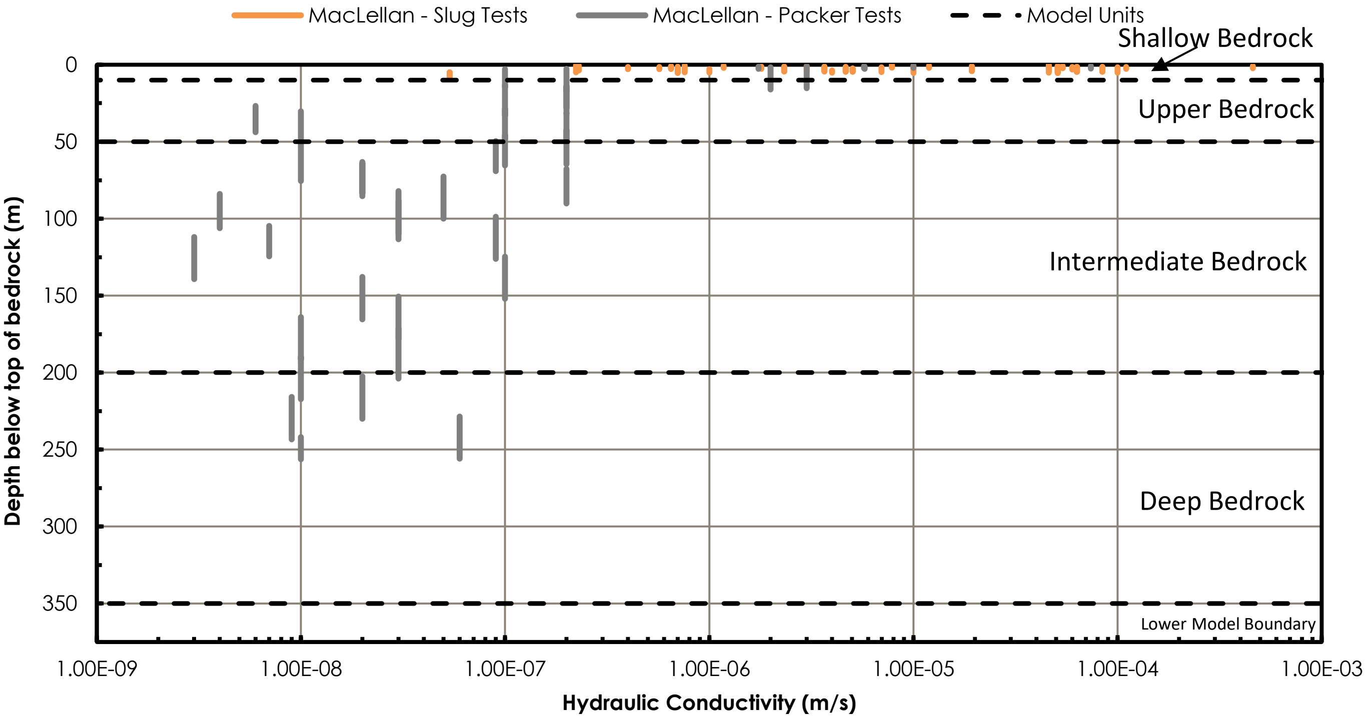
111473008

Map No.
IAAC-61-2

Title
Overburden Thickness - MacLellan

A.2 ATTACHMENT IAAC-62





Notes:

Pumping test represent fractured interval of borehole

Client/Project

Lynn Lake Gold Project (LLGP)

Figure No.

IAAC-62-1

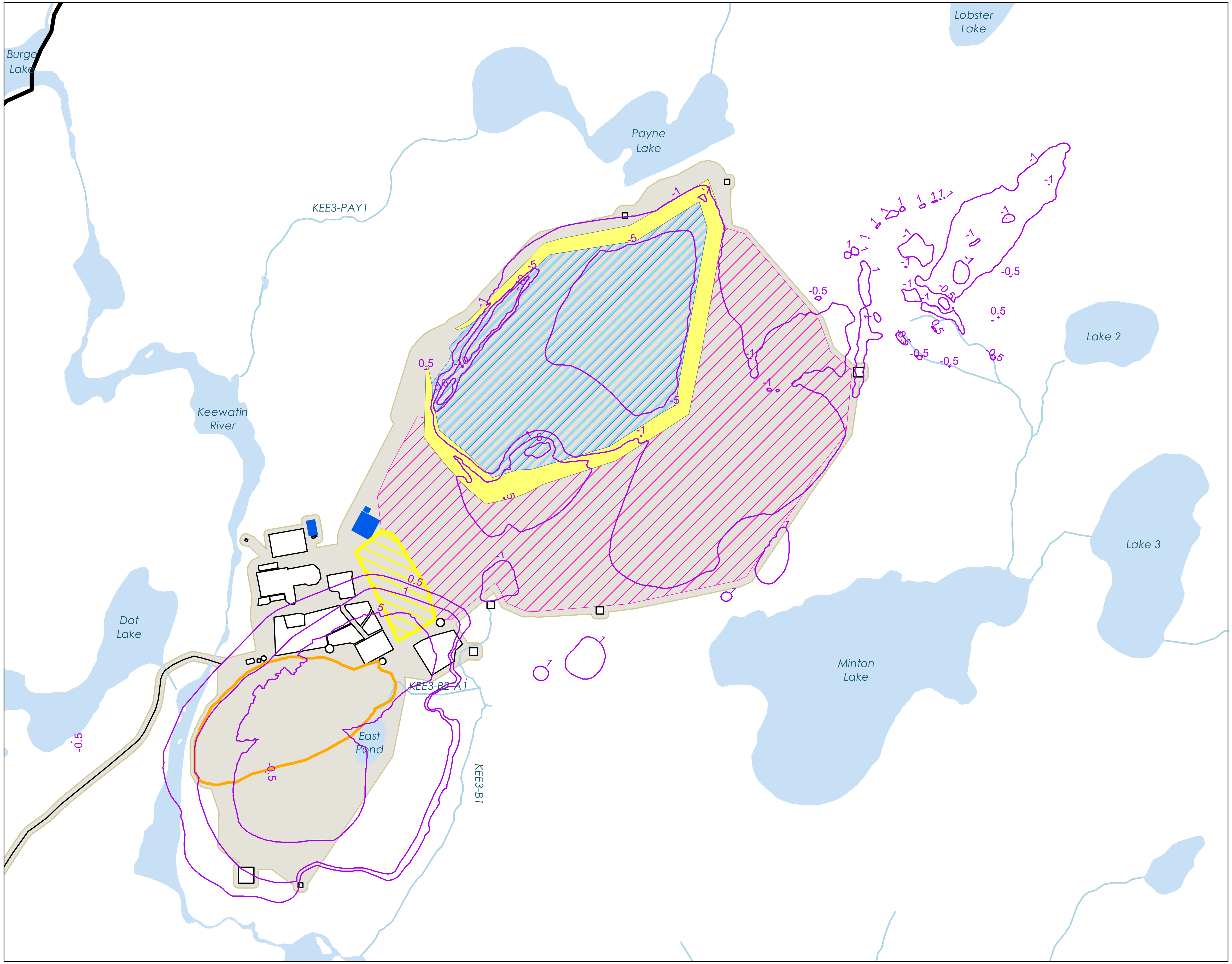
Title

Horizontal Hydraulic Conductivity with Depth

Stantec

\\Ca0045-ppfss01\workgroup\1114\Active\111473010\Round_1_IRs\Package 2\Author working files\groundwater\IAAC-62\fig_hydraulic conductivity.xlsx

A.3 ATTACHMENT IAAC-63



Stantec

Project Infrastructure

- 🟧 Proposed Open Pit
- ▨ Proposed Mine Rock Stockpile
- ▨ Proposed Overburden Stockpile
- 🟨 Proposed Tailings Management Facility
- ▨ Proposed Tailings Management Facility Pond
- 🟦 Other Proposed Ponds
- ☐ Other Proposed Areas
- ■ Project Development Area

Study Area

- ☐ Groundwater Local Assessment Area (LAA) and Regional Assessment Area (RAA)

Survey Locations

- — Water Table Drawdown Contours

Landbase

- — Existing Access Road
- — Watercourse
- ■ Waterbody

N

0 250 500 Metres
(At original document size of 11x17)
1:25,000

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada.

Project Location
Lynn Lake,
Manitoba

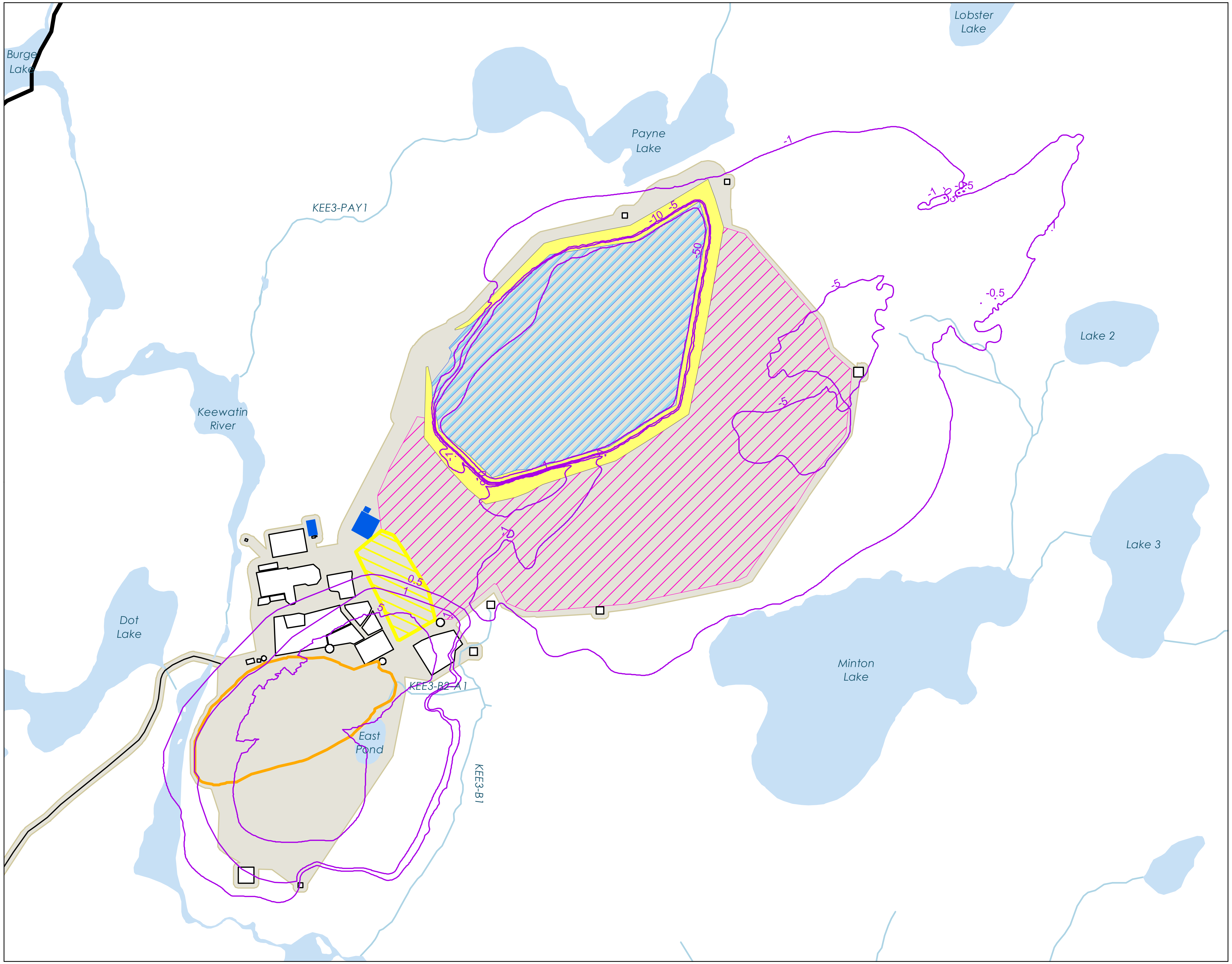
Prepared by ACampigotto on 2021-05-27
Technical Review by JKeizer on 2021-05-27

Client/Project
111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-63-1

Title
Simulated Water Table Drawdown at End of Closure - MacLellan Site (including contact water collection ditches)

G:_GIS_Project_Folder\111473008_LLGP_EA\IRs\Hydro-Geology\IAAC-63\Map_IAAC-63-1_GROUNDWATER_WaterTableDrawdown_EoC_MacLellan_20210527.mxd Revised: 2021-05-27 By: ACampigotto



Stantec

Project Infrastructure

- Proposed Open Pit
- Proposed Mine Rock Stockpile
- Proposed Overburden Stockpile
- Proposed Tailings Management Facility
- Proposed Tailings Management Facility Pond
- Other Proposed Ponds
- Other Proposed Areas
- Project Development Area

Study Area

- Groundwater Local Assessment Area (LAA) and Regional Assessment Area (RAA)

Survey Locations

- Water Table Drawdown Contours

Landbase

- Existing Access Road
- Watercourse
- Waterbody

N

0 250 500 Metres
(At original document size of 11x17)
1:25,000

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N

2. Base Data Sources: Government of Manitoba and Government of Canada.

Project Location
Lynn Lake,
Manitoba

Prepared by ACampigotto on 2021-05-27
Technical Review by JKeizer on 2021-05-27

Client/Project
111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-63-2

Title
Simulated Water Table Drawdown at End of Closure - MacLellan Site (no contact water collection ditches)

G:_GIS_Project_Folder\111473008_LLGP_EA\IRs\Hydro-Geology\IAAC-63\Map_IAAC_63-2_GROUNDWATER_WaterTableDrawdown_EoC_NoContactWater_MacLellan_20210527.mxd Revised: 2021-05-27 By: ACampigotto

A.4 ATTACHMENT IAAC-68

Table 2A
Summary of Hydraulic Response Testing, Gordon Site
Lynn Lake Gold Project (LLGP)
Hydrogeology Baseline Technical Data Report

Monitoring Well	Tested Interval		Screened Material Description	Hydrostratigraphic Unit	Hydraulic Conductivity			
	Top m BGS	Bottom m BGS			Test 1 m/sec	Test 2 m/sec	Test 3 m/sec	Geometric Mean m/sec
Glaciolacustrine Offshore								
MWF-04B	3.7	6.7	Sandy Clayey Silt/Silt and Sand/ Boulders	Glaciolacustrine Offshore / Sand Diamicton	1.32E-06	-	-	1E-06
GBHF-11B	4.6	6.1	Silty Sand	Glaciolacustrine Offshore	6.20E-07	-	-	6E-07
Geometric Mean of Glaciolacustrine Offshore Deposits								**9E-07**
Glaciolacustrine Nearshore								
MWF-02B	5.2	8.2	Silty Sand, Boulders, Gravel	Glaciofluvial / Glaciolacustrine Nearshore	1.22E-06	1.24E-06	-	1E-06
MWF-03B	1.8	3.4	Silty Sand	Glaciolacustrine Nearshore	4.36E-06	2.03E-06	-	3E-06
GBHF-01B	4.0	5.5	Silty Sand	Glaciolacustrine Nearshore	1.10E-04	-	-	1E-04
GBHF-04B	3.4	4.9	Gravel / Bedrock	Glaciolacustrine Nearshore / Bedrock	1.20E-05	1.60E-05	-	1E-05
GBHF-05B	9.1	10.7	Silty Sand	Glaciolacustrine Nearshore	6.90E-06	-	-	7E-06
GBHF-16-02B	3.4	4.9	Sand	Glaciolacustrine Nearshore	4.00E-07	2.00E-07	-	3E-07
Geometric Mean of Glaciolacustrine Nearshore Deposits								**5E-06**
Sand Diamicton								
GBHF-07B	1.7	3.3	Clayey Silty Sand to Silty Sand	Sand Diamicton	1.80E-06	-	-	2E-06
GBHF-09B	7.6	9.1	Silty Sand	Sand Diamicton	2.00E-07	-	-	2E-07
MWF-07S	9.5	11.6	Sand	Sand Diamicton	5.62E-07	-	-	6E-07
MWF-08S	8.8	10.4	Silty Sand	Sand Diamicton	1.48E-06	-	-	1E-06
GBHF-16-01B	4.0	5.5	Peat, Silty Clay, Silty Sand and Gravel	Glaciolacustrine Offshore / Sand Diamicton	3.00E-05	-	-	3E-05
Geometric Mean of Sand Diamicton								**2E-06**
Shallow Bedrock (<50 m below top of bedrock)								
MWF-02A	11.3	14.3	Bedrock	Bedrock	2.30E-06	2.52E-06	3.19E-06	3E-06
MWF-03A	6.1	9.1	Bedrock	Bedrock	1.64E-06	1.11E-06	-	1E-06
MWF-04A	8.8	11.9	Bedrock	Bedrock	9.51E-05	1.14E-04	1.53E-04	1E-04
MWF-05A	5.8	6.9	Bedrock	Bedrock	4.32E-05	4.18E-05	3.08E-05	4E-05
MWF-06	2.0	5.2	Bedrock	Bedrock	1.63E-07	-	-	2E-07
MWF-07R	28.8	30.7	Bedrock	Bedrock	9.19E-06	-	-	9E-06
MWF-08R	13.7	15.2	Bedrock	Bedrock	2.93E-05	-	-	3E-05
GBHF-01A	5.8	7.3	Bedrock	Bedrock	9.10E-05	-	-	9E-05
GBHF-02A	4.0	5.5	Bedrock	Bedrock	2.30E-04	-	-	2E-04
GBHF-03	2.9	4.9	Bedrock	Bedrock	7.60E-05	3.80E-05	-	5E-05
GBHF-04A	5.5	7.0	Bedrock	Bedrock	5.10E-05	5.10E-05	-	5E-05
GBHF-05A	12.5	14.0	Bedrock	Bedrock	9.10E-06			9E-06
GBHF-07A	4.9	6.4	Bedrock	Bedrock	1.10E-04	4.10E-05	-	7E-05
GBHF-09A	11.1	12.7	Bedrock	Bedrock	2.50E-07	-	-	3E-07
GBHF-10A	4.2	6.0	Bedrock	Bedrock	2.30E-06	-	-	2E-06
GBHF-11A	7.5	9.0	Bedrock	Bedrock	2.30E-04	-	-	2E-04
GBHF-13	4.0	7.0	Bedrock	Bedrock	1.80E-05	-	-	2E-05
GBHF-16-01	7.6	9.1	Bedrock	Bedrock	1.00E-04	-	-	1E-04
GBHF-16-02	11.3	15.2	Bedrock	Bedrock	7.00E-08	-	-	7E-08
GBHF-16-02A	9.1	10.7	Bedrock	Bedrock	4.00E-06	3.00E-06	-	3E-06
GBHG-17-01	33.4	34.9	Bedrock	Bedrock	3.00E-06	3.00E-06	-	3E-06
GBHG-17-01	20.4	25.6	Bedrock	Bedrock	9.00E-04	-	-	9E-04
GBHG-17-01	20.4	30.0	Bedrock	Bedrock	1.00E-04	-	-	1E-04
GBHG-17-01	20.4	33.8	Bedrock	Bedrock	8.00E-05	-	-	8E-05
GBHG-17-01	20.4	38.1	Bedrock	Bedrock	7.00E-05	-	-	7E-05
GBHG-17-02	24.3	25.8	Bedrock	Bedrock	7.00E-06	-	-	7E-06
GBHG-17-02	11.3	13.4	Bedrock	Bedrock	2.00E-06	-	-	2E-06
GBHG-17-02	11.3	16.5	Bedrock	Bedrock	4.00E-05	-	-	4E-05
GBHG-17-02	11.3	19.5	Bedrock	Bedrock	1.00E-05	-	-	1E-05
GBHG-17-02	11.3	22.3	Bedrock	Bedrock	1.00E-05	-	-	1E-05
GBHG-17-02	11.3	26.3	Bedrock	Bedrock	5.00E-05	-	-	5E-05
GTF-15-05	4.8	19.3	Bedrock	Bedrock	1.00E-05	-	-	1E-05
GTF-15-05	17.8	34.9	Bedrock	Bedrock	2.00E-06	-	-	2E-06
Geometric Mean of Shallow Bedrock								**1E-05**
Deep Bedrock (>50 m below bedrock)								
GTF-15-05	33.4	53.0	Bedrock	Bedrock	3.00E-07	-	-	3E-07
GTF-15-05	51.6	71.2	Bedrock	Bedrock	1.00E-07	-	-	1E-07
GTF-15-05	69.8	89.4	Bedrock	Bedrock	5.00E-07	-	-	5E-07
GTF-15-05	88.0	112.8	Bedrock	Bedrock	6.00E-07	-	-	6E-07
GTF-15-05	111.4	125.8	Bedrock	Bedrock	4.00E-08	-	-	4E-08
Geometric Mean of Deep Bedrock								**2E-07**

Notes:

Hydraulic conductivity testing completed by Stantec at MWF monitoring wells

Hydraulic conductivity testing completed by Golder at GBHF, GBHG, and GTF monitoring wells

Hydraulic conductivity tests not completed at MWF-01B and MWF-05B due to insufficient water in monitoring well to complete test

Table 2B
Summary of Hydraulic Response Testing, MacLellan Site
Lynn Lake Gold Project (LLGP)
Hydrogeology Baseline Technical Data Report

Monitoring Well	Tested Interval		Screened Material Description	Hydrostratigraphc Unit	Hydraulic Conductivity Estimate					
	Top m BGS	Bottom m BGS			Test 1 m/sec	Test 2 m/sec	Test 3 m/sec	Test 4 m/sec	Test 5 m/sec	Geometric Mean m/sec
Glaciolacustrine Nearshore										
MWM-02B	1.2	2.1	Overburden - Silty Sand	Glaciolacustrine Nearshore	2.78E-07	-	-	-	-	3E-07
MWM-03	7	8.5	Overburden - Sand and Gravel	Glaciolacustrine Nearshore/ Glaciofluvial	1.05E-07	-	-	-	-	1E-07
MWM-05B	11	14	Overburden - Sand	Glaciolacustrine Nearshore	4.22E-06	4.35E-06	-	-	-	4E-06
MWM-06B	1.8	3.5	Overburden - Sand	Glaciolacustrine Nearshore	1.17E-06	1.17E-06	1.18E-06	-	-	1E-06
MWM-09B	3	4.6	Overburden - Sand and Gravel	Glaciolacustrine Nearshore	9.19E-06	9.19E-06	8.42E-06	-	-	9E-06
MWM-10B	5	6.6	Overburden - Sand and Cobbles/Boulders	Glaciolacustrine Nearshore/ Glaciofluvial	5.60E-05	5.35E-05	6.19E-05	-	-	6E-05
MWM-11S	1.52	3.05	Silty Sand to Gravelly Sand	Glaciolacustrine Nearshore/ Glaciofluvial	4.45E-07	-	-	-	-	4E-07
GBHM-03B	1.65	4.7	Silty Sand	Glaciolacustrine Nearshore	7.80E-07	-	-	-	-	8E-07
GBHM-11B	0.75	1.68	Sand	Glaciolacustrine Nearshore	7.70E-07	-	-	-	-	8E-07
GBHM-22B	3.88	7.9	Silty Sand	Glaciolacustrine Nearshore	1.00E-06	-	-	-	-	1E-06
GBHM-16-01B	1.68	3.2	Sand	Glaciolacustrine Nearshore	2.00E-06	2.00E-06	-	-	-	2E-06
GBHM-16-04S	0.53	1.75	Silty Sand	Glaciolacustrine Nearshore	1.30E-05	-	-	-	-	1E-05
GBHM-16-08S	13.46	15.42	Sand to Gravelly Sand	Glaciolacustrine Nearshore/ Glaciofluvial	4.50E-07	-	-	-	-	4E-07
GBHM-17-02S	2.74	4.27	Sand	Glaciolacustrine Nearshore	1.83E-06	-	-	-	-	2E-06
GBHM-17-05S	2.44	3.96	Silty Sand to Sand and Gravel	Glaciolacustrine Nearshore	3.34E-05	3.12E-06	-	-	-	1E-05
							Geometric Mean of Glaciolacustrine Nearshore Deposits			**2E-06**
Glaciolacustrine Offshore										
MWM-13B**	9.15	10.67	Clay and Silty Clay	Glaciolacustrine Offshore	2.30E-05	2.20E-05	2.40E-05	-	-	2E-05
							Geometric Mean of Glaciolacustrine Offshore Deposits			**2E-05**
Sand Diamicton										
GBHM-01B	9.15	10.67	Silty Sand	Sand Diamicton	6.20E-05	-	-	-	-	6E-05
GBHM-05B	2.34	5.38	Sand and Silt	Sand Diamicton	2.10E-05	-	-	-	-	2E-05
GBHM-06B	0.76	1.52	Silty Sand	Sand Diamicton	4.20E-07	-	-	-	-	4E-07
GBHM-10B	0.92	3.35	Silty Sand	Sand Diamicton	1.00E-05	-	-	-	-	1E-05
GBHM-13B	1.5	3.1	Silty Clay, Silty Sand, Clayey Sand	Glaciolacustrine Offshore / Sand Diamicton	2.00E-05	1.00E-05	-	-	-	1E-05
							Geometric Mean of Sand Diamicton			**9E-06**
Shallow Bedrock (<50 m below top of bedrock)										
BH18-01B**	4.81	9.4	Bedrock	Bedrock	8.30E-07	7.20E-07	7.30E-07	-	-	8E-07
BH18-01B**	5.64	9.38	Bedrock	Bedrock	7.00E-07	-	-	-	-	7E-07
BH18-02**	1.6	6.17	Bedrock	Bedrock	5.20E-05	4.80E-05	5.00E-05	5.20E-05	5.30E-05	5E-05
BH18-02**	3.25	6.17	Bedrock	Bedrock	1.00E-05	1.00E-05		-	-	1E-05
BH18-03**	2.36	5.4	Bedrock	Bedrock	7.60E-06	6.40E-06	7.00E-06	-	-	7E-06
BH18-03**	1.94	5.4	Bedrock	Bedrock	3.00E-06	-	-	-	-	3E-06
BH18-04B**	6.13	8.73	Bedrock	Bedrock	7.00E-07	-	-	-	-	7E-07
BH18-05**	2.76	6.32	Bedrock	Bedrock	1.00E-04	-	-	-	-	1E-04
BH18-06**	1.09	5.87	Bedrock	Bedrock	4.50E-05	4.60E-05	4.50E-05	4.80E-05	-	5E-05
BH18-07**	1.22	5.79	Bedrock	Bedrock	3.30E-07	1.50E-07	-	-	-	2E-07
MWM-01A	11.90	13.40	Bedrock	Bedrock	4.91E-05	5.57E-05	5.75E-05	-	-	5E-05
MWM-02A	4.60	6.70	Bedrock	Bedrock	4.81E-06	5.27E-06	-	-	-	5E-06
MWM-04	2.50	5.60	Bedrock	Bedrock	4.73E-05	7.83E-05	6.84E-05	-	-	6E-05
MWM-05A	17.40	20.40	Bedrock	Bedrock	4.35E-06	4.81E-06	4.81E-06	-	-	5E-06
MWM-06A	4.60	7.60	Bedrock	Bedrock	3.65E-06	3.73E-06	3.62E-06	-	-	4E-06
MWM-07A	3.60	6.70	Bedrock	Bedrock	4.83E-05	5.69E-05	9.13E-05	-	-	6E-05
MWM-08	6.10	9.10	Bedrock	Bedrock	5.35E-08	-	-	-	-	5E-08
MWM-09A	6.00	9.10	Bedrock	Bedrock	2.29E-06	2.29E-06	2.40E-06	-	-	2E-06
MWM-10A	9.10	12.20	Bedrock	Bedrock	8.54E-05	8.54E-05	8.23E-05	-	-	8E-05
MWM-11R	3.61	5.13	Bedrock	Bedrock	7.86E-06	-	-	-	-	8E-06
MWM-13A**	8.61	11.66	Bedrock	Bedrock	1.80E-05	1.90E-05	2.10E-05	-	-	2E-05
GBHM-01A	18.00	21.05	Bedrock	Bedrock	4.60E-05	-	-	-	-	5E-05
GBHM-02A	5.51	7.04	Bedrock	Bedrock	6.50E-07	-	-	-	-	7E-07
GBHM-03A	7.22	8.74	Bedrock	Bedrock	3.00E-06	-	-	-	-	3E-06
GBHM-04	0.91	2.44	Bedrock	Bedrock	4.60E-04	-	-	-	-	5E-04
GBHM-05A	7.62	9.14	Bedrock	Bedrock	5.70E-07	-	-	-	-	6E-07
GBHM-06A	2.82	4.34	Bedrock	Bedrock	1.80E-06	-	-	-	-	2E-06
GBHM-09A	3.51	4.73	Bedrock	Bedrock	1.10E-04	-	-	-	-	1E-04
GBHM-10A	4.57	7.62	Bedrock	Bedrock	2.30E-07	-	-	-	-	2E-07
GBHM-11A	3.58	5.11	Bedrock	Bedrock	1.50E-04	-	-	-	-	2E-04
GBHM-13A	3.96	7.01	Bedrock	Bedrock	8.00E-05	-	-	-	-	8E-05
GBHM-15	3.51	6.55	Bedrock	Bedrock	2.00E-08	-	-	-	-	2E-08
GBHM-18	16.76	19.81	Bedrock	Bedrock	6.00E-06	-	-	-	-	6E-06
GBHM-19	3.05	6.10	Bedrock	Bedrock	1.00E-05	-	-	-	-	1E-05
GBHM-20	1.98	5.03	Bedrock	Bedrock	7.00E-05	-	-	-	-	7E-05
GBHM-22A	9.91	12.95	Bedrock	Bedrock	3.00E-06	-	-	-	-	3E-06
GBHM-16-01A	5.18	6.71	Bedrock	Bedrock	1.00E-05	-	-	-	-	1E-05
GBHM-16-02A	8.53	10.06	Bedrock	Bedrock	3.00E-08	-	-	-	-	3E-08
GBHM-16-03R	25.65	27.18	Bedrock	Bedrock	3.00E-07	-	-	-	-	3E-07
GBHM-16-03	26.01	27.70	Bedrock	Bedrock	5.00E-08	-	-	-	-	5E-08
GBHM-16-03	27.55	29.46	Bedrock	Bedrock	8.00E-07	-	-	-	-	8E-07
GBHM-16-04R	3.29	4.81	Bedrock	Bedrock	1.17E-06	-	-	-	-	1E-06
GBHM-16-04	4.05	5.60	Bedrock	Bedrock	4.00E-07	-	-	-	-	4E-07
GBHM-16-04	5.55	7.80	Bedrock	Bedrock	1.00E-06	-	-	-	-	1E-06
GBHM16-06	30.18	31.70	Bedrock	Bedrock	4.00E-06	-	-	-	-	4E-06
GBHM-16-08R	22.58	24.11	Bedrock	Bedrock	1.19E-05	-	-	-	-	1E-05
GBHM-16-09	2.33	3.85	Bedrock	Bedrock	6.00E-05	-	-	-	-	6E-05
GBHM-17-02R	10.30	11.82	Bedrock	Bedrock	1.00E-05	-	-	-	-	1E-05
GBHM-17-03	2.80	4.32	Bedrock	Bedrock	5.76E-06	-	-	-	-	6E-06
GBHM-17-04	3.71	5.23	Bedrock	Bedrock	1.74E-06	-	-	-	-	2E-06
GBHM-17-05R	6.00	7.52	Bedrock	Bedrock	7.40E-05	-	-	-	-	7E-05
GBHM-17-06R	6.83	8.36	Bedrock	Bedrock	5.73E-06	-	-	-	-	6E-06
GTM-15-01	2.82	14.67	Bedrock	Bedrock	1.00E-07	-	-	-	-	1E-07
GTM-15-01	13.22	32.86	Bedrock	Bedrock	1.00E-07	-	-	-	-	1E-07
GTM-15-01	31.4	51.04	Bedrock	Bedrock	2.00E-07	-	-	-	-	2E-07
GTM-15-02	2.61	17.07	Bedrock	Bedrock	2.00E-07	-	-	-	-	2E-07
GTM-15-02	28.59	48.24	Bedrock	Bedrock	1.00E-07	-	-	-	-	1E-07
GTM-15-03	0.8	15.26	Bedrock	Bedrock	3.00E-06	-	-	-	-	3E-06
GTM-15-03	13.79	28.25	Bedrock	Bedrock	2.00E-07	-	-	-	-	2E-07
GTM-15-03	26.78	43.84	Bedrock	Bedrock	6.00E-09	-	-	-	-	6E-09
GTM-15-04	1.6	16.06	Bedrock	Bedrock	2.00E-06	-	-	-	-	2E-06
GTM-15-04	14.59	31.65	Bedrock	Bedrock	2.00E-07	-	-	-	-	2E-07
							Geometric Mean of Shallow Bedrock			**3E-06**
Deep Bedrock (>50 m below bedrock)										
GTM-15-01	49.59	69.23	Bedrock	Bedrock	9.00E-08	-	-	-	-	9E-08
GTM-15-01	67.78	90.02	Bedrock	Bedrock	2.00E-07	-	-	-	-	2E-07
GTM-15-01	88.56	113.4	Bedrock	Bedrock	3.00E-08	-	-	-	-	3E-08
GTM-15-01	111.94	139.38	Bedrock	Bedrock	3.00E-09	-	-	-	-	3E-09
GTM-15-01	137.92	165.36	Bedrock	Bedrock	2.00E-08	-	-	-	-	2E-08
GTM-15-01	163.91	191.34	Bedrock	Bedrock	1.00E-08	-	-	-	-	1E-08
GTM-15-01	189.89	217.32	Bedrock	Bedrock	1.00E-08	-	-	-	-	1E-08
GTM-15-01	215.87	243.3	Bedrock	Bedrock	9.00E-09	-	-	-	-	9E-09
GTM-15-01	241.85	256.29	Bedrock	Bedrock	1.00E-08	-	-	-	-	1E-08
GTM-15-02	48.1	75.55	Bedrock	Bedrock	1.00E-08	-	-	-	-	1E-08
GTM-15-02	72.65	100.09	Bedrock	Bedrock	5.00E-08	-	-	-	-	5E-08
GTM-15-02	98.69	126.13	Bedrock	Bedrock	9.00E-08	-	-	-	-	9E-08
GTM-15-02	124.67	152.11	Bedrock	Bedrock	1.00E-07	-	-	-	-	1E-07
GTM-15-02	150.65	178.1	Bedrock	Bedrock	3.00E-08	-	-	-	-	3E-08
GTM-15-02	171.31	203.95	Bedrock	Bedrock	3.00E-08	-	-	-	-	3E-08
GTM-15-02	202.49	229.94	Bedrock	Bedrock	2.00E-08	-	-	-	-	2E-08
GTM-15-02	228.47	255.92	Bedrock	Bedrock	6.00E-08	-	-	-	-	6E-08
GTM-15-03	42.37	64.62	Bedrock	Bedrock	2.00E-07	-	-	-	-	2E-07
GTM-15-03	63.16	85.41	Bedrock	Bedrock	2.00E-08	-	-	-	-	2E-08
GTM-15-03	83.94	106.19	Bedrock	Bedrock	4.00E-09	-	-	-	-	4E-09
GTM-15-03	104.73	124.38	Bedrock	Bedrock	7.00E-09	-	-	-	-	7E-09
GTM-15-04	30.18	47.23	Bedrock	Bedrock	1.00E-08	-	-	-	-	1E-08
GTM-15-04	45.77	65.42	Bedrock	Bedrock	1.00E-07	-	-	-	-	1E-07
GTM-15-04	63.96	83.61	Bedrock	Bedrock	2.00E-08	-	-	-	-	2E-08
GTM-15-04	82.14	109.59	Bedrock	Bedrock	3.00E-08	-	-	-	-	3E-08
							Geometric Mean of Deep Bedrock			**3E-08**

Notes:

Hydraulic conductivity testing completed by Stantec at MWM and BH monitoring wells

Hydraulic conductivity testing completed by Golder at GBHM and GTM monitoring wells

* Hydraulic conductivity tests not completed by Stantec at MWM-01B and MWM-07B due to insufficient water in monitoring well to complete test

** Hydraulic conductivity tests completed between October 2016 and July 2019

Table 3A
Summary of Vertical Hydraulic Gradients, Gordon Site
Lynn Lake Gold Project (LLGP)
Hydrogeology Baseline Technical Data Report

Well ID	Water Level Date	Groundwater Elevation m AMSL	Screen Mid Point m AMSL	dl m	dh m	i m/m	Flow Direction
GBHF-01A	1-Aug-15	314.94	309.49	-0.01	-1.86	0.007	Down
GBHF-01B	1-Aug-15	314.95	311.35				
GBHF-01A	25-Sep-15	315.03	309.49	0.12	-1.86	-0.063	Up
GBHF-01B	25-Sep-15	314.91	311.35				
GBHF-01A	17-May-16	314.99	309.49	-0.03	-1.86	0.018	Down
GBHF-01B	17-May-16	315.02	311.35				
GBHF-01A	7-Aug-16	314.85	309.49	0.12	-1.86	-0.063	Up
GBHF-01B	7-Aug-16	314.73	311.35				
GBHF-01A	2-Oct-16	314.95	309.49	0.03	-1.86	-0.014	Up
GBHF-01B	2-Oct-16	314.92	311.35				
GBHF-01A	13-Jun-17	315.08	309.49	-0.02	-1.86	0.012	Down
GBHF-01B	12-Jun-17	315.10	311.35				
GBHF-01A	12-Aug-17	314.92	309.49	-0.02	-1.86	0.012	Down
GBHF-01B	12-Aug-17	314.94	311.35				
GBHF-01A	7-Oct-17	314.81	309.49	0.14	-1.86	-0.074	Up
GBHF-01B	7-Oct-17	314.67	311.35				
GBHF-01A	28-Jun-18	315.06	309.49	0.00	-1.86	0.002	Down
GBHF-01B	28-Jun-18	315.06	311.35				
GBHF-01A	24-Aug-18	314.92	309.49	0.21	-1.86	-0.111	Up
GBHF-01B	24-Aug-18	314.71	311.35				
GBHF-01A	23-Oct-18	317.02	309.49	-0.01	-1.86	0.007	Down
GBHF-01B	23-Oct-18	317.03	311.35				
GBHF-01A	8-Jul-19	315.22	309.49	0.07	-1.86	-0.036	Up
GBHF-01B	8-Jul-19	315.15	311.35				
GBHF-04A	3-Aug-15	314.40	311.27	-0.28	-2.38	0.119	Down
GBHF-04B	3-Aug-15	314.69	313.65				
GBHF-04A	26-Sep-15	314.46	311.27	-0.24	-2.38	0.102	Down
GBHF-04B	26-Sep-15	314.71	313.65				
GBHF-04A	16-May-16	314.43	311.27	-0.28	-2.38	0.119	Down
GBHF-04B	16-May-16	314.72	313.65				
GBHF-04A	6-Aug-16	314.34	311.27	-0.24	-2.38	0.102	Down
GBHF-04B	6-Aug-16	314.59	313.65				
GBHF-04A	4-Oct-16	314.48	311.27	-0.24	-2.38	0.102	Down
GBHF-04B	4-Oct-16	314.73	313.65				
GBHF-04A	9-Jun-17	314.63	311.27	-0.28	-2.38	0.119	Down
GBHF-04B	9-Jun-17	314.92	313.65				
GBHF-04A	10-Aug-17	314.47	311.27	-0.25	-2.38	0.107	Down
GBHF-04B	10-Aug-17	314.73	313.65				
GBHF-04A	7-Oct-17	314.42	311.27	-0.26	-2.38	0.111	Down
GBHF-04B	7-Oct-17	314.69	313.65				
GBHF-04A	28-Jun-18	314.67	311.27	-0.31	-2.38	0.132	Down
GBHF-04B	28-Jun-18	314.99	313.65				

Table 3A
Summary of Vertical Hydraulic Gradients, Gordon Site
Lynn Lake Gold Project (LLGP)
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Well ID	Water Level Date	Groundwater Elevation m AMSL	Screen Mid Point m AMSL	dl m	dh m	i m/m	Flow Direction
GBHF-04A	26-Aug-18	314.53	311.27	-0.24	-2.38	0.102	Down
GBHF-04B	26-Aug-18	314.78	313.65				
GBHF-04A	23-Oct-18	314.61	311.27	-0.26	-2.38	0.111	Down
GBHF-04B	23-Oct-18	314.88	313.65				
GBHF-04A	11-Jul-19	314.76	311.27	-0.36	-2.38	0.153	Down
GBHF-04B	10-Jul-19	315.13	313.65				
GBHF-05A	1-Aug-15	314.62	303.66	0.03	-3.39	-0.007	Up
GBHF-05B	1-Aug-15	314.60	307.05				
GBHF-05A	25-Sep-15	314.77	303.66	-0.04	-3.39	0.010	Down
GBHF-05B	25-Sep-15	314.81	307.05				
GBHF-05A	17-May-16	314.76	303.66	-0.03	-3.39	0.010	Down
GBHF-05B	16-May-16	314.80	307.05				
GBHF-05A	6-Aug-16	314.50	303.66	-0.02	-3.39	0.007	Down
GBHF-05B	6-Aug-16	314.53	307.05				
GBHF-05A	2-Oct-16	314.73	303.66	0.00	-3.39	-0.001	Up
GBHF-05B	2-Oct-16	314.73	307.05				
GBHF-05A	12-Jun-17	314.89	303.66	-0.02	-3.39	0.007	Down
GBHF-05B	12-Jun-17	314.92	307.05				
GBHF-05A	12-Aug-17	314.72	303.66	0.00	-3.39	0.001	Down
GBHF-05B	11-Aug-17	314.73	307.05				
GBHF-05A	11-Oct-17	314.50	303.66	0.02	-3.39	-0.004	Up
GBHF-05B	11-Oct-17	314.49	307.05				
GBHF-05A	28-Jun-18	314.95	303.66	-1.07	-3.39	0.315	Down
GBHF-05B	28-Jun-18	316.02	307.05				
GBHF-05A	24-Aug-18	314.68	303.66	-0.02	-3.39	0.007	Down
GBHF-05B	24-Aug-18	314.71	307.05				
GBHF-05A	8-Jul-19	315.02	303.66	-0.05	-3.39	0.016	Down
GBHF-05B	8-Jul-19	315.08	307.05				
GBHF-07A	3-Aug-15	318.18	313.17	-0.05	-3.22	0.014	Down
GBHF-07B	3-Aug-15	318.22	316.39				
GBHF-07A	25-Sep-15	318.28	313.17	-0.08	-3.22	0.026	Down
GBHF-07B	25-Sep-15	318.36	316.39				
GBHF-07A	19-May-16	318.19	313.17	-0.14	-3.22	0.045	Down
GBHF-07B	19-May-16	318.33	316.39				
GBHF-07A	7-Aug-16	318.14	313.17	-0.01	-3.22	0.005	Down
GBHF-07B	7-Aug-16	318.15	316.39				
GBHF-07A	4-Oct-16	318.20	313.17	-0.10	-3.22	0.033	Down
GBHF-07B	4-Oct-16	318.30	316.39				
GBHF-07A	27-Jun-17	318.23	313.17	0.11	-3.22	-0.033	Up
GBHF-07B	27-Jun-17	318.12	316.39				
GBHF-07A	11-Aug-17	318.11	313.17	0.16	-3.22	-0.048	Up
GBHF-07B	11-Aug-17	317.95	316.39				

Table 3A
Summary of Vertical Hydraulic Gradients, Gordon Site
Lynn Lake Gold Project (LLGP)
Hydrogeology Baseline Technical Data Report

Well ID	Water Level Date	Groundwater Elevation m AMSL	Screen Mid Point m AMSL	dl m	dh m	i m/m	Flow Direction
GBHF-07A	10-Oct-17	317.88	313.17	0.00	-3.22	0.002	Down
GBHF-07B	10-Oct-17	317.88	316.39				
GBHF-07A	3-Jul-18	318.23	313.17	0.07	-3.22	-0.023	Up
GBHF-07B	3-Jul-18	318.15	316.39				
GBHF-07A	26-Aug-18	318.02	313.17	-0.03	-3.22	0.011	Down
GBHF-07B	26-Aug-18	318.05	316.39				
GBHF-07A	23-Oct-18	318.12	313.17	-0.06	-3.22	0.017	Down
GBHF-07B	24-Oct-18	318.17	316.39				
GBHF-07A	10-Jul-19	318.46	313.17	0.19	-3.22	-0.057	Up
GBHF-07B	11-Jul-19	318.27	316.39				
GBHF-09A	30-Jul-15	317.41	305.22	0.11	-3.58	-0.031	Up
GBHF-09B	30-Jul-15	317.30	308.80				
GBHF-09A	25-Sep-15	317.38	305.22	0.12	-3.58	-0.035	Up
GBHF-09B	25-Sep-15	317.26	308.80				
GBHF-09A	2-Oct-16	317.36	305.22	0.45	-3.58	-0.127	Up
GBHF-09B	2-Oct-16	316.91	308.80				
GBHF-09A	13-Jun-17	317.55	305.22	0.05	-3.58	-0.015	Up
GBHF-09B	13-Jun-17	317.50	308.80				
GBHF-09A	11-Aug-17	317.48	305.22	0.04	-3.58	-0.012	Up
GBHF-09B	11-Aug-17	317.44	308.80				
GBHF-09A	6-Oct-17	317.07	305.22	0.25	-3.58	-0.071	Up
GBHF-09B	6-Oct-17	316.82	308.80				
GBHF-09A	4-Jul-18	317.77	305.22	0.45	-3.58	-0.127	Up
GBHF-09B	3-Jul-18	317.32	308.80				
GBHF-09A	27-Aug-18	317.29	305.22	-0.13	-3.58	0.035	Down
GBHF-09B	26-Aug-18	317.42	308.80				
GBHF-10A	28-Sep-15	326.20	324.02	-0.02	-2.81	0.007	Down
GBHF-10B	28-Sep-15	326.22	326.83				
GBHF-10A	18-May-16	325.69	324.02	-1.39	-2.81	0.494	Down
GBHF-10B	18-May-16	327.08	326.83				
GBHF-10A	3-Oct-16	326.49	324.02	0.01	-2.81	-0.004	Up
GBHF-10B	3-Oct-16	326.48	326.83				
GBHF-10A	10-Aug-17	326.30	324.02	-0.06	-2.81	0.021	Down
GBHF-10B	10-Aug-17	326.36	326.83				
GBHF-10A	4-Jul-18	327.02	324.02	-0.68	-2.81	0.242	Down
GBHF-10B	4-Jul-18	327.70	326.83				
GBHF-10A	27-Aug-18	326.27	324.02	-0.01	-2.81	0.003	Down
GBHF-10B	27-Aug-18	326.28	326.83				
GBHF-10A	25-Oct-18	326.14	324.02	0.06	-2.81	-0.022	Up
GBHF-10B	25-Oct-18	326.08	326.83				
GBHF-10A	10-Jul-19	327.10	324.02	-0.33	-2.81	0.117	Down
GBHF-10B	10-Jul-19	327.43	326.83				

Table 3A
Summary of Vertical Hydraulic Gradients, Gordon Site
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Well ID	Water Level Date	Groundwater Elevation m AMSL	Screen Mid Point m AMSL	dl m	dh m	i m/m	Flow Direction
GBHF-11A	19-May-16	325.51	312.93	4.60	-3.01	-1.527	Up
GBHF-11B	19-May-16	320.91	315.94				
GBHF-11A	7-Aug-16	325.61	312.93	3.55	-3.01	-1.179	Up
GBHF-11B	8-Aug-16	322.06	315.94				
GBHF-11A	2-Oct-16	325.42	312.93	3.52	-3.01	-1.169	Up
GBHF-11B	3-Oct-16	321.90	315.94				
GBHF-11A	21-Jun-17	325.81	312.93	3.95	-3.01	-1.311	Up
GBHF-11B	21-Jun-17	321.86	315.94				
GBHF-11A	11-Aug-17	325.54	312.93	4.04	-3.01	-1.341	Up
GBHF-11B	11-Aug-17	321.50	315.94				
GBHF-11A	6-Oct-17	325.20	312.93	3.63	-3.01	-1.205	Up
GBHF-11B	6-Oct-17	321.57	315.94				
GBHF-11A	3-Jul-18	325.27	312.93	3.35	-3.01	-1.112	Up
GBHF-11B	3-Jul-18	321.92	315.94				
GBHF-11A	27-Aug-18	325.37	312.93	3.66	-3.01	-1.215	Up
GBHF-11B	27-Aug-18	321.71	315.94				
GBHF-11A	9-Jul-19	324.70	312.93	2.96	-3.01	-0.983	Up
GBHF-11B	9-Jul-19	321.74	315.94				
GBHF-12A	29-Sep-15	323.73	317.53	-0.12	-4.08	0.029	Down
GBHF-12B	29-Sep-15	323.85	321.61				
GBHF-12A	8-Aug-16	322.25	317.53	-1.82	-4.08	0.446	Down
GBHF-12B	8-Aug-16	324.07	321.61				
GBHF-12A	4-Oct-16	324.30	317.53	-0.06	-4.08	0.015	Down
GBHF-12B	4-Oct-16	324.36	321.61				
GBHF-12A	28-Jun-17	324.66	317.53	0.60	-4.08	-0.147	Up
GBHF-12B	28-Jun-17	324.06	321.61				
GBHF-12A	10-Aug-17	324.11	317.53	0.04	-4.08	-0.010	Up
GBHF-12B	10-Aug-17	324.07	321.61				
GBHF-12A	6-Oct-17	323.47	317.53	-0.64	-4.08	0.157	Down
GBHF-12B	10-Oct-17	324.11	321.61				
GBHF-12A	4-Jul-18	324.34	317.53	0.21	-4.08	-0.051	Up
GBHF-12B	4-Jul-18	324.13	321.61				
GBHF-12A	28-Aug-18	324.19	317.53	0.20	-4.08	-0.049	Up
GBHF-12B	28-Aug-18	323.99	321.61				
GBHF-12A	10-Jul-19	324.38	317.53	0.22	-4.08	-0.054	Up
GBHF-12B	10-Jul-19	324.16	321.61				
GBHF-16-01	12-Aug-17	305.38	305.95	-4.07	-4.06	1.003	Down
GBHF-16-01	12-Aug-17	309.45	310.005				
GBHF-16-01	7-Oct-17	312.35	305.95	-0.06	-4.06	0.014	Down
GBHF-16-01	7-Oct-17	312.41	310.005				

Table 3A
Summary of Vertical Hydraulic Gradients, Gordon Site
Lynn Lake Gold Project (LLGP)
Hydrogeology Baseline Technical Data Report

Well ID	Water Level Date	Groundwater Elevation m AMSL	Screen Mid Point m AMSL	dl m	dh m	i m/m	Flow Direction
GBHF-16-01	29-Jun-18	312.68	305.95	-0.15	-4.06	0.036	Down
GBHF-16-01	29-Jun-18	312.83	310.005				
GBHF-16-01	24-Aug-18	312.47	305.95	-0.23	-4.06	0.056	Down
GBHF-16-01	24-Aug-18	312.70	310.005				
GBHF-16-01	8-Jul-19	312.78	305.95	0.09	-4.06	-0.023	Up
GBHF-16-01	8-Jul-19	312.69	310.005				
GBHF-16-02	11-Aug-17	312.97	303.285	-0.62	-6.39	0.097	Down
GBHF-16-02	12-Aug-17	313.60	309.675				
GBHF-16-02	7-Oct-17	313.02	303.285	-0.51	-6.39	0.080	Down
GBHF-16-02	7-Oct-17	313.54	309.675				
GBHF-16-02	3-Jul-18	313.06	303.285	-0.51	-6.39	0.080	Down
GBHF-16-02	3-Jul-18	313.58	309.675				
GBHF-16-02	24-Aug-18	312.91	303.285	-0.56	-6.39	0.088	Down
GBHF-16-02	24-Aug-18	313.48	309.675				
GBHF-16-02	11-Jul-19	312.94	303.285	-0.74	-6.39	0.116	Down
GBHF-16-02	10-Jul-19	313.69	309.675				
MWF-01A	23-Oct-18	321.03	322.55	-4.68	-3.38	1.386	Down
MWF-01B	23-Oct-18	325.71	325.93				
MWF-02A	1-Aug-15	317.60	309.25	0.07	-6.23	-0.011	Up
MWF-02B	1-Aug-15	317.53	315.48				
MWF-02A	26-Sep-15	317.58	309.25	0.04	-6.23	-0.006	Up
MWF-02B	26-Sep-15	317.54	315.48				
MWF-02A	17-May-16	317.28	309.25	0.12	-6.23	-0.019	Up
MWF-02B	17-May-16	317.16	315.48				
MWF-02A	7-Aug-16	317.72	309.25	0.07	-6.23	-0.011	Up
MWF-02B	7-Aug-16	317.65	315.48				
MWF-02A	3-Oct-16	317.64	309.25	0.00	-6.23	0.000	Down
MWF-02B	3-Oct-16	317.64	315.48				
MWF-02A	10-Jun-17	318.16	309.25	0.25	-6.23	-0.040	Up
MWF-02B	10-Jun-17	317.91	315.48				
MWF-02A	12-Aug-17	317.32	309.25	-0.51	-6.23	0.082	Down
MWF-02B	11-Aug-17	317.83	315.48				
MWF-02A	10-Oct-17	317.32	309.25	0.04	-6.23	-0.006	Up
MWF-02B	10-Oct-17	317.28	315.48				
MWF-02A	2-Jul-18	318.35	309.25	0.34	-6.23	-0.054	Up
MWF-02B	2-Jul-18	318.01	315.48				
MWF-02A	29-Aug-18	318.12	309.25	0.37	-6.23	-0.059	Up
MWF-02B	29-Aug-18	317.75	315.48				
MWF-02A	25-Oct-18	318.00	309.25	0.15	-6.23	-0.024	Up
MWF-02B	25-Oct-18	317.85	315.48				

Table 3A
Summary of Vertical Hydraulic Gradients, Gordon Site
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Well ID	Water Level Date	Groundwater Elevation	Screen Mid Point	dl	dh	i	Flow Direction
		m AMSL	m AMSL	m	m	m/m	
MWF-02A	11-Jul-19	318.42	309.25	1.11	-6.23	-0.178	Up
MWF-02B	11-Jul-19	317.31	315.48				
MWF-03A	3-Aug-15	325.45	317.86	0.03	-5.17	-0.006	Up
MWF-03B	3-Aug-15	325.42	323.03				
MWF-03A	23-Sep-15	325.46	317.86	-0.02	-5.17	0.003	Down
MWF-03B	23-Sep-15	325.48	323.03				
MWF-03A	18-May-16	325.49	317.86	-0.15	-5.17	0.029	Down
MWF-03B	18-May-16	325.64	323.03				
MWF-03A	6-Aug-16	325.43	317.86	0.08	-5.17	-0.016	Up
MWF-03B	6-Aug-16	325.35	323.03				
MWF-03A	3-Oct-16	325.46	317.86	0.07	-5.17	-0.014	Up
MWF-03B	3-Oct-16	325.39	323.03				
MWF-03A	14-Jun-17	325.57	317.86	0.00	-5.17	0.000	Up
MWF-03B	14-Jun-17	325.57	323.03				
MWF-03A	10-Aug-17	325.34	317.86	-0.04	-5.17	0.007	Down
MWF-03B	10-Aug-17	325.38	323.03				
MWF-03A	5-Oct-17	325.28	317.86	-0.03	-5.17	0.005	Down
MWF-03B	6-Oct-17	325.31	323.03				
MWF-03A	29-Jun-18	325.59	317.86	-0.04	-5.17	0.007	Down
MWF-03B	29-Jun-18	325.63	323.03				
MWF-03A	28-Aug-18	325.42	317.86	0.01	-5.17	-0.002	Up
MWF-03B	28-Aug-18	325.41	323.03				
MWF-03A	9-Jul-19	325.60	317.86	0.01	-5.17	-0.002	Up
MWF-03B	9-Jul-19	325.59	323.03				
MWF-04A	3-Aug-15	314.11	304.69	-0.03	-5.02	0.006	Down
MWF-04B	3-Aug-15	314.14	309.72				
MWF-04A	23-Sep-15	313.80	304.69	-0.04	-5.02	0.008	Down
MWF-04B	23-Sep-15	313.84	309.72				
MWF-04A	19-May-16	314.23	304.69	-0.01	-5.02	0.002	Down
MWF-04B	19-May-16	314.24	309.72				
MWF-04A	6-Aug-16	314.06	304.69	0.07	-5.02	-0.014	Up
MWF-04B	6-Aug-16	313.99	309.72				
MWF-04A	3-Oct-16	313.86	304.69	0.01	-5.02	-0.002	Up
MWF-04B	4-Oct-16	313.85	309.72				
MWF-04A	21-Jun-17	314.93	304.69	0.24	-5.02	-0.047	Up
MWF-04B	21-Jun-17	314.69	309.72				
MWF-04A	10-Aug-17	313.92	304.69	-0.04	-5.02	0.008	Down
MWF-04B	11-Aug-17	313.96	309.72				
MWF-04A	6-Oct-17	313.59	304.69	0.13	-5.02	-0.025	Up
MWF-04B	10-Oct-17	313.46	309.72				
MWF-04A	29-Jun-18	315.10	304.69	0.26	-5.02	-0.051	Up
MWF-04B	29-Jun-18	314.84	309.72				

Table 3A
Summary of Vertical Hydraulic Gradients, Gordon Site
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Well ID	Water Level Date	Groundwater Elevation m AMSL	Screen Mid Point m AMSL	dl m	dh m	i m/m	Flow Direction
MWF-04A	26-Aug-18	313.92	304.69	-0.01	-5.02	0.002	Down
MWF-04B	26-Aug-18	313.93	309.72				
MWF-04A	9-Jul-19	315.56	304.69	0.61	-5.02	-0.121	Up
MWF-04B	9-Jul-19	314.95	309.72				
MWF-05A	28-Jul-15	299.57	295.80	-0.06	-2.80	0.021	Down
MWF-05B	28-Jul-15	299.62	298.59				
MWF-05A	30-Jul-15	299.33	295.80	-0.24	-2.80	0.086	Down
MWF-05B	30-Jul-15	299.57	298.59				
MWF-05A	16-May-16	298.99	295.80	-0.05	-2.80	0.019	Down
MWF-05B	16-May-16	299.04	298.59				
MWF-05A	8-Aug-16	299.89	295.80	0.00	-2.80	0.001	Down
MWF-05B	8-Aug-16	299.89	298.59				
MWF-05A	2-Oct-16	299.91	295.80	0.05	-2.80	-0.017	Up
MWF-05B	2-Oct-16	299.86	298.59				
MWF-05A	8-Jun-17	300.58	295.80	-0.49	-2.80	0.176	Down
MWF-05B	8-Jun-17	301.07	298.59				
MWF-05A	10-Aug-17	299.98	295.80	-0.02	-2.80	0.008	Down
MWF-05B	10-Aug-17	300.00	298.59				
MWF-05A	28-Aug-18	299.95	295.80	-0.02	-2.80	0.008	Down
MWF-05B	28-Aug-18	299.97	298.59				
MWF-05A	19-Oct-18	300.27	295.80	-0.02	-2.80	0.008	Down
MWF-05B	19-Oct-18	300.29	298.59				
MWF-05A	8-Jul-19	301.12	295.80	-0.45	-2.80	0.162	Down
MWF-05B	8-Jul-19	301.57	298.59				
DPF-01	28-Sep-15	316.78	315.34	0.01	-1.46	-0.010	Up
DPF-01 SW	28-Sep-15	316.76	316.80				
DPF-01	9-Oct-16	316.77	315.34	0.01	-1.46	-0.007	Up
DPF-01 SW	9-Oct-16	316.76	316.80				
DPF-01	2-Jul-18	316.986	315.34	0.00	-1.46	0.000	Down
DPF-01 SW	2-Jul-18	316.986	316.80				
DPF-01	25-Aug-18	317.016	315.34	0.00	-1.46	0.000	Down
DPF-01 SW	25-Aug-18	317.016	316.80				
DPF-01	23-Oct-18	317.096	315.34	0.00	-1.46	0.000	Down
DPF-01 SW	23-Oct-18	317.096	316.80				
DPF-01	10-Jul-19	317.226	315.34	0.03	-1.46	-0.018	Up
DPF-01 SW	10-Jul-19	317.2	316.80				
DPF-02	6-Aug-16	315.567	314.38	0.01	-0.84	-0.012	Up
DPF-02 SW	6-Aug-16	315.557	315.22				
DPF-02	13-Oct-16	315.60	314.38	-0.05	-0.84	0.063	Down
DPF-02 SW	13-Oct-16	315.65	315.22				

Table 3A
Summary of Vertical Hydraulic Gradients, Gordon Site
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Well ID	Water Level Date	Groundwater Elevation m AMSL	Screen Mid Point m AMSL	dl m	dh m	i m/m	Flow Direction
DPF-02	10-Jun-17	315.627	314.38	-0.19	-0.84	0.227	Down
DPF-02 SW	10-Jun-17	315.817	315.22				
DPF-02	10-Aug-17	315.697	314.38	0.06	-0.84	-0.072	Up
DPF-02 SW	10-Aug-17	315.637	315.22				
DPF-02	10-Oct-17	315.697	314.38	0.00	-0.84	0.000	Down
DPF-02 SW	10-Oct-17	315.697	315.22				
DPF-02	4-Jul-18	316.087	314.38	-0.02	-0.84	0.024	Down
DPF-02 SW	4-Jul-18	316.107	315.22				
DPF-02	27-Aug-18	315.777	314.38	0.01	-0.84	-0.012	Up
DPF-02 SW	27-Aug-18	315.767	315.22				
DPF-02	23-Oct-18	315.937	314.38	-0.01	-0.84	0.012	Down
DPF-02 SW	23-Oct-18	315.947	315.22				
DPF-02	10-Jul-19	316.167	314.38	0.02	-0.84	-0.024	Up
DPF-02 SW	10-Jul-19	316.147	315.22				
DPF-03	6-Aug-16	313.947	312.20	0.03	-0.90	-0.033	Up
DPF-03 SW	6-Aug-16	313.917	313.10				
DPF-03	13-Oct-16	314.19	312.20	0.01	-0.90	-0.008	Up
DPF-03 SW	13-Oct-16	314.18	313.10				
DPF-04	28-Sep-15	323.15	322.56	n/a	-1.30	n/a	Down
DPF-04 SW	28-Sep-15	dry	323.86				
DPF-04	1-Aug-15	324.88	322.56	0.40	-1.30	-0.309	Up
DPF-04 SW	1-Aug-15	324.48	323.86				
DPF-04	6-Aug-16	323.85	322.56	0.00	-1.30	0.000	Down
DPF-04 SW	6-Aug-16	323.85	323.86				
DPF-04	4-Oct-16	323.27	322.56	-0.59	-1.30	0.456	Down
DPF-04 SW	4-Oct-16	323.86	323.86				
DPF-04	10-Jun-17	324.275	322.56	0.00	-1.30	0.000	Down
DPF-04 SW	10-Jun-17	324.275	323.86				
DPF-04	2-Jul-18	324.205	322.56	0.02	-1.30	-0.015	Up
DPF-04 SW	2-Jul-18	324.185	323.86				
DPF-04	25-Aug-18	323.855	322.56	0.03	-1.30	-0.023	Up
DPF-04 SW	25-Aug-18	323.825	323.86				
DPF-04	23-Oct-18	323.145	322.56	-1.63	-1.30	1.259	Down
DPF-04 SW	23-Oct-18	324.775	323.86				
DPF-04	8-Jul-19	323.955	322.56	0.02	-1.30	-0.015	Up
DPF-04 SW	8-Jul-19	323.935	323.86				

Table 3B
Summary of Vertical Hydraulic Gradients, MacLellan Site
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Well ID	Water Level Date	Groundwater Elevation m AMSL	Screen Mid Point m AMSL	dl m	dh m	i m/m	Flow Direction
GBHM-01A	29-Jul-2015	332.282	315.459	-1.50	-9.60	0.156	Down
GBHM-01B	29-Jul-2015	333.779	325.056				
GBHM-01A	5-Aug-2016	318.807	315.459	-13.49	-9.60	1.405	Down
GBHM-01B	5-Aug-2016	332.293	325.056				
GBHM-01A	9-Aug-2017	321.717	315.459	-10.54	-9.60	1.098	Down
GBHM-01B	9-Aug-2017	332.253	325.056				
GBHM-01A	3-Oct-2017	321.377	315.459	-10.89	-9.60	1.134	Down
GBHM-01B	3-Oct-2017	332.263	325.056				
GBHM-01A	22-Jun-2018	323.007	315.459	-9.48	-9.60	0.987	Down
GBHM-01B	22-Jun-2018	332.483	325.056				
GBHM-01A	23-Aug-2018	323.297	315.459	-9.08	-9.60	0.946	Down
GBHM-01B	23-Aug-2018	332.373	325.056				
GBHM-01A	28-Jun-2019	324.447	315.459	-7.70	-9.60	0.802	Down
GBHM-01B	28-Jun-2019	332.143	325.056				
GBHM-02A	29-Jul-2015	333.806	328.043	2.55	-3.47	-0.735	Up
GBHM-02B	29-Jul-2015	331.252	331.517				
GBHM-02A	31-Jul-2015	333.811	328.043	2.57	-3.47	-0.741	Up
GBHM-02B	31-Jul-2015	331.237	331.517				
GBHM-02A	3-Oct-2017	333.721	328.043	0.13	-3.47	-0.037	Up
GBHM-02B	3-Oct-2017	333.591	331.517				
GBHM-02A	23-Aug-2018	330.531	328.043	-3.14	-3.47	0.903	Down
GBHM-02B	23-Aug-2018	333.667	331.517				
GBHM-02A	26-Jun-2019	333.771	328.043	0.05	-3.47	-0.016	Up
GBHM-02B	26-Jun-2019	333.717	331.517				
GBHM-03A	28-Jul-15	336.48	328.69	0.01	-4.64	-0.002	Up
GBHM-03B	28-Jul-15	336.47	333.33				
GBHM-03A	28-Sep-15	336.44	328.69	0.03	-4.64	-0.007	Up
GBHM-03B	28-Sep-15	336.41	333.33				
GBHM-03A	15-May-16	336.50	328.69	0.29	-4.64	-0.063	Up
GBHM-03B	15-May-16	336.21	333.33				
GBHM-03A	5-Aug-16	336.44	328.69	0.07	-4.64	-0.015	Up
GBHM-03B	5-Aug-16	336.37	333.33				
GBHM-03A	16-Jun-17	336.49	328.69	0.04	-4.64	-0.009	Up
GBHM-03B	16-Jun-17	336.45	333.33				
GBHM-03A	8-Aug-17	336.36	328.69	0.02	-4.64	-0.005	Up
GBHM-03B	8-Aug-17	336.34	333.33				
GBHM-03A	5-Oct-17	336.36	328.69	0.06	-4.64	-0.013	Up
GBHM-03B	5-Oct-17	336.30	333.33				
GBHM-03A	23-Jun-18	336.51	328.69	0.21	-4.64	-0.045	Up
GBHM-03B	23-Jun-18	336.30	333.33				
GBHM-03A	21-Aug-18	336.61	328.69	0.29	-4.64	-0.063	Up
GBHM-03B	24-Aug-18	336.32	333.33				

Table 3B
Summary of Vertical Hydraulic Gradients, MacLellan Site
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Well ID	Water Level Date	Groundwater Elevation m AMSL	Screen Mid Point m AMSL	dl m	dh m	i m/m	Flow Direction
GBHM-05A	28-Jul-15	330.73	323.82	-0.03	-4.57	0.006	Down
GBHM-05B	28-Jul-15	330.76	328.39				
GBHM-05A	3-Aug-15	330.77	323.82	-0.06	-4.57	0.013	Down
GBHM-05B	3-Aug-15	330.83	328.39				
GBHM-05A	28-Sep-15	330.42	323.82	-0.13	-4.57	0.028	Down
GBHM-05B	28-Sep-15	330.55	328.39				
GBHM-05A	15-May-16	330.61	323.82	-0.11	-4.57	0.024	Down
GBHM-05B	15-May-16	330.72	328.39				
GBHM-05A	4-Aug-16	330.71	323.82	-0.09	-4.57	0.019	Down
GBHM-05B	4-Aug-16	330.80	328.39				
GBHM-05A	7-Oct-16	330.64	323.82	-0.07	-4.57	0.015	Down
GBHM-05B	7-Oct-16	330.71	328.39				
GBHM-05A	16-Jun-17	331.16	323.82	0.83	-4.57	-0.182	Up
GBHM-05B	17-Jun-17	330.33	328.39				
GBHM-05A	8-Aug-17	330.65	323.82	-0.09	-4.57	0.019	Down
GBHM-05B	8-Aug-17	330.74	328.39				
GBHM-05A	3-Oct-17	330.36	323.82	-0.07	-4.57	0.015	Down
GBHM-05B	3-Oct-17	330.43	328.39				
GBHM-05A	25-Jun-18	330.67	323.82	-0.12	-4.57	0.026	Down
GBHM-05B	25-Jun-18	330.79	328.39				
GBHM-05A	23-Aug-18	330.45	323.82	-0.03	-4.57	0.006	Down
GBHM-05B	23-Aug-18	330.48	328.39				
GBHM-05A	16-Oct-18	330.67	323.82	-0.10	-4.57	0.022	Down
GBHM-05B	16-Oct-18	330.77	328.39				
GBHM-05A	28-Jun-19	330.92	323.82	-0.15	-4.57	0.033	Down
GBHM-05B	28-Jun-19	331.07	328.39				
GBHM-06A	29-Jul-15	341.98	339.44	0.14	-2.36	-0.060	Up
GBHM-06B	29-Jul-15	341.84	341.80				
GBHM-06A	22-Sep-15	341.84	339.44	0.15	-2.36	-0.064	Up
GBHM-06B	22-Sep-15	341.69	341.80				
GBHM-06A	15-May-16	341.67	339.44	0.12	-2.36	-0.051	Up
GBHM-06B	15-May-16	341.55	341.80				
GBHM-06A	3-Aug-16	342.34	339.44	0.08	-2.36	-0.034	Up
GBHM-06B	3-Aug-16	342.26	341.80				
GBHM-06A	1-Oct-16	342.13	339.44	0.17	-2.36	-0.073	Up
GBHM-06B	1-Oct-16	341.96	341.80				
GBHM-06A	7-Jun-17	342.88	339.44	0.09	-2.36	-0.039	Up
GBHM-06B	7-Jun-17	342.79	341.80				
GBHM-06A	8-Aug-17	341.99	339.44	0.11	-2.36	-0.047	Up
GBHM-06B	8-Aug-17	341.88	341.80				
GBHM-06A	23-Jun-18	342.45	339.44	0.09	-2.36	-0.039	Up
GBHM-06B	23-Jun-18	342.36	341.80				
GBHM-06A	23-Aug-18	341.80	339.44	0.08	-2.36	-0.034	Up
GBHM-06B	23-Aug-18	341.72	341.80				

Table 3B
Summary of Vertical Hydraulic Gradients, MacLellan Site
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Well ID	Water Level Date	Groundwater Elevation m AMSL	Screen Mid Point m AMSL	dl m	dh m	i m/m	Flow Direction
GBHM-06A	17-Oct-18	342.16	339.44	0.10	-2.36	-0.043	Up
GBHM-06B	17-Oct-18	342.06	341.80				
GBHM-06A	26-Jun-19	342.87	339.44	0.45	-2.36	-0.191	Up
GBHM-06B	26-Jun-19	342.42	341.80				
GBHM-09A	4-Aug-16	346.20	343.68	0.12	-2.75	-0.042	Up
GBHM-09B	4-Aug-16	346.08	346.43				
GBHM-09A	16-Jun-17	346.83	343.68	2.07	-2.75	-0.751	Up
GBHM-09B	1-Jun-17	344.76	346.43				
GBHM-09A	22-Jun-18	346.64	343.68	0.06	-2.75	-0.020	Up
GBHM-09B	22-Jun-18	346.58	346.43				
GBHM-09A	15-Oct-18	346.02	343.68	0.07	-2.75	-0.027	Up
GBHM-09B	15-Oct-18	345.94	346.43				
GBHM-09A	24-Jun-19	346.54	343.68	0.15	-2.75	-0.056	Up
GBHM-09B	24-Jun-19	346.38	346.43				
GBHM-10A	29-Sep-15	337.73	333.37	-0.68	-3.99	0.170	Down
GBHM-10B	29-Sep-15	338.41	337.36				
GBHM-10A	18-May-16	337.96	333.37	-0.05	-3.99	0.012	Down
GBHM-10B	18-May-16	338.01	337.36				
GBHM-10A	3-Aug-16	338.72	333.37	-0.17	-3.99	0.042	Down
GBHM-10B	3-Aug-16	338.89	337.36				
GBHM-10A	5-Oct-16	338.47	333.37	-0.24	-3.99	0.060	Down
GBHM-10B	5-Oct-16	338.71	337.36				
GBHM-10A	16-Jun-17	339.38	333.37	0.17	-3.99	-0.043	Up
GBHM-10B	16-Jun-17	339.21	337.36				
GBHM-10A	9-Aug-17	338.15	333.37	-0.19	-3.99	0.047	Down
GBHM-10B	9-Aug-17	338.34	337.36				
GBHM-10A	2-Oct-17	337.15	333.37	-0.26	-3.99	0.065	Down
GBHM-10B	2-Oct-17	337.41	337.36				
GBHM-10A	22-Jun-18	338.97	333.37	0.13	-3.99	-0.033	Up
GBHM-10B	22-Jun-18	338.84	337.36				
GBHM-10A	21-Aug-18	338.00	333.37	-0.21	-3.99	0.052	Down
GBHM-10B	21-Aug-18	338.21	337.36				
GBHM-10A	16-Oct-18	338.22	333.37	-0.14	-3.99	0.035	Down
GBHM-10B	16-Oct-18	338.36	337.36				
GBHM-10A	24-Jun-19	337.65	333.37	-1.01	-3.99	0.253	Down
GBHM-10B	24-Jun-19	338.66	337.36				
GBHM-11A	28-Jul-15	343.92	340.88	-0.12	-3.21	0.036	Down
GBHM-11B	28-Jul-15	344.04	344.09				
GBHM-11A	22-Sep-15	343.36	340.88	-0.27	-3.21	0.086	Down
GBHM-11B	22-Sep-15	343.64	344.09				
GBHM-11A	15-May-16	343.80	340.88	0.05	-3.21	-0.014	Up
GBHM-11B	15-May-16	343.76	344.09				

Table 3B
Summary of Vertical Hydraulic Gradients, MacLellan Site
Lynn Lake Gold Project (LLGP)
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Well ID	Water Level Date	Groundwater Elevation m AMSL	Screen Mid Point m AMSL	dl m	dh m	i m/m	Flow Direction
GBHM-11A	3-Aug-16	343.87	340.88	-0.17	-3.21	0.051	Down
GBHM-11B	3-Aug-16	344.04	344.09				
GBHM-11A	15-Jun-17	344.70	340.88	0.13	-3.21	-0.039	Up
GBHM-11B	1-Jun-17	344.58	344.09				
GBHM-11A	9-Aug-17	343.74	340.88	-0.19	-3.21	0.061	Down
GBHM-11B	9-Aug-17	343.94	344.09				
GBHM-11A	22-Jun-18	344.58	340.88	0.12	-3.21	-0.039	Up
GBHM-11B	22-Jun-18	344.46	344.09				
GBHM-11A	17-Oct-18	343.83	340.88	-0.18	-3.21	0.055	Down
GBHM-11B	16-Oct-18	344.01	344.09				
GBHM-11A	24-Jun-19	344.64	340.88	0.02	-3.21	-0.008	Up
GBHM-11B	24-Jun-19	344.62	344.09				
GBHM-13A	30-Jul-15	343.16	337.59	0.10	-3.19	-0.032	Up
GBHM-13B	30-Jul-15	343.06	340.78				
GBHM-13A	26-Sep-15	343.12	337.59	0.92	-3.19	-0.289	Up
GBHM-13B	26-Sep-15	342.20	340.78				
GBHM-13A	4-Aug-16	343.13	337.59	0.08	-3.19	-0.025	Up
GBHM-13B	4-Aug-16	343.05	340.78				
GBHM-13A	8-Oct-16	343.09	337.59	0.12	-3.19	-0.038	Up
GBHM-13B	8-Oct-16	342.97	340.78				
GBHM-13A	18-Jun-17	342.68	337.59	-0.25	-3.19	0.078	Down
GBHM-13B	18-Jun-17	342.93	340.78				
GBHM-13A	9-Aug-17	343.00	337.59	0.13	-3.19	-0.041	Up
GBHM-13B	9-Aug-17	342.87	340.78				
GBHM-13A	3-Oct-17	342.96	337.59	0.10	-3.19	-0.032	Up
GBHM-13B	3-Oct-17	342.86	340.78				
GBHM-13A	26-Jun-18	343.08	337.59	0.20	-3.19	-0.063	Up
GBHM-13B	26-Jun-18	342.88	340.78				
GBHM-13A	21-Aug-18	343.01	337.59	0.14	-3.19	-0.044	Up
GBHM-13B	21-Aug-18	342.87	340.78				
GBHM-13A	28-Jun-19	342.51	337.59	-0.41	-3.19	0.128	Down
GBHM-13B	28-Jun-19	342.92	340.78				
GBHM-22A	31-Jul-15	337.70	326.62	0.82	-5.50	-0.150	Up
GBHM-22B	31-Jul-15	336.88	332.12				
GBHM-22A	26-Sep-15	337.79	326.62	0.06	-5.50	-0.011	Up
GBHM-22B	26-Sep-15	337.73	332.12				
GBHM-22A	4-Aug-16	337.82	326.62	0.06	-5.50	-0.011	Up
GBHM-22B	4-Aug-16	337.76	332.12				
GBHM-22A	8-Oct-16	337.84	326.62	0.09	-5.50	-0.017	Up
GBHM-22B	8-Oct-16	337.75	332.12				
GBHM-22A	17-Jun-17	337.79	326.62	-0.07	-5.50	0.012	Down
GBHM-22B	17-Jun-17	337.86	332.12				
GBHM-22A	9-Aug-17	337.72	326.62	0.11	-5.50	-0.021	Up
GBHM-22B	9-Aug-17	337.61	332.12				

Table 3B
Summary of Vertical Hydraulic Gradients, MacLellan Site
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Well ID	Water Level Date	Groundwater Elevation m AMSL	Screen Mid Point m AMSL	dl m	dh m	i m/m	Flow Direction
GBHM-22A	3-Oct-17	337.58	326.62	0.06	-5.50	-0.011	Up
GBHM-22B	3-Oct-17	337.52	332.12				
GBHM-22A	26-Jun-18	337.79	326.62	0.02	-5.50	-0.004	Up
GBHM-22B	26-Jun-18	337.77	332.12				
GBHM-22A	21-Aug-18	337.74	326.62	0.01	-5.50	-0.002	Up
GBHM-22B	21-Aug-18	337.73	332.12				
GBHM-22A	29-Jun-19	337.84	326.62	0.01	-5.50	-0.002	Up
GBHM-22B	29-Jun-19	337.83	332.12				
GBHM-23A	22-Aug-18	333.42	325.79	-3.97	-5.49	0.724	Down
GBHM-23B	22-Aug-18	337.39	331.28				
GBHM-23A	29-Jun-19	339.03	325.79	-0.07	-5.49	0.013	Down
GBHM-23B	29-Jun-19	339.10	331.28				
GBHM-16-01R	27-Jun-17	330.98	324.96	0.81	-3.40	-0.239	Up
GBHM-16-01S	27-Jun-17	330.17	328.35				
GBHM-16-01R	9-Aug-17	330.05	324.96	0.23	-3.40	-0.068	Up
GBHM-16-01S	8-Aug-17	329.82	328.35				
GBHM-16-01R	3-Oct-17	329.95	324.96	0.41	-3.40	-0.121	Up
GBHM-16-01S	3-Oct-17	329.54	328.35				
GBHM-16-01R	25-Jun-18	330.59	324.96	0.40	-3.40	-0.118	Up
GBHM-16-01S	25-Jun-18	330.19	328.35				
GBHM-16-01R	24-Aug-18	329.95	324.96	0.66	-3.40	-0.194	Up
GBHM-16-01S	23-Aug-18	329.29	328.35				
GBHM-16-01R	18-Oct-18	330.20	324.96	0.21	-3.40	-0.062	Up
GBHM-16-01S	17-Oct-18	329.99	328.35				
GBHM-16-01R	28-Jun-19	330.80	324.96	1.09	-3.40	-0.321	Up
GBHM-16-01S	28-Jun-19	329.71	328.35				
GBHM-16-02R	1-Jun-17	330.42	322.30	1.08	-3.40	-0.318	Up
GBHM-16-02S	1-Jun-17	329.34	325.80				
GBHM-16-02R	8-Aug-17	329.86	322.30	1.08	-3.50	-0.309	Up
GBHM-16-02S	8-Aug-17	328.78	325.80				
GBHM-16-02R	3-Oct-17	329.50	322.30	1.04	-3.50	-0.297	Up
GBHM-16-02S	3-Oct-17	328.46	325.80				
GBHM-16-02R	23-Jun-18	329.89	322.30	1.43	-3.50	-0.409	Up
GBHM-16-02S	23-Jun-18	328.46	325.80				
GBHM-16-02R	23-Aug-18	329.61	322.30	3.80	-3.50	-1.086	Up
GBHM-16-02S	23-Aug-18	325.81	325.80				
GBHM-16-02R	28-Jun-19	329.89	322.30	0.85	-3.50	-0.243	Up
GBHM-16-02S	28-Jun-19	329.04	325.80				
MWM-01A	2-Aug-15	343.97	330.75	5.47	-8.73	-0.627	Up
MWM-01B	2-Aug-15	338.50	339.48				
MWM-01A	23-Sep-15	343.86	330.75	5.38	-8.73	-0.617	Up
MWM-01B	23-Sep-15	338.48	339.48				

Table 3B
Summary of Vertical Hydraulic Gradients, MacLellan Site
Lynn Lake Gold Project (LLGP)
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Well ID	Water Level Date	Groundwater Elevation m AMSL	Screen Mid Point m AMSL	dl m	dh m	i m/m	Flow Direction
MWM-01A	8-Aug-17	343.78	330.75	1.04	-8.73	-0.120	Up
MWM-01B	9-Aug-17	342.74	339.48				
MWM-01A	4-Oct-17	343.76	330.75	1.00	-8.73	-0.115	Up
MWM-01B	4-Oct-17	342.76	339.48				
MWM-01A	23-Jun-18	343.71	330.75	0.93	-8.73	-0.107	Up
MWM-01B	23-Jun-18	342.78	339.48				
MWM-01A	22-Aug-18	343.38	330.75	0.64	-8.73	-0.074	Up
MWM-01B	22-Aug-18	342.74	339.48				
MWM-01A	18-Oct-18	344.08	330.75	1.26	-8.73	-0.145	Up
MWM-01B	18-Oct-18	342.82	339.48				
MWM-02A	2-Aug-15	349.92	344.05	0.43	-4.17	-0.103	Up
MWM-02B	2-Aug-15	349.49	348.22				
MWM-02A	23-Sep-15	349.67	344.05	0.41	-4.17	-0.098	Up
MWM-02B	24-Sep-15	349.26	348.22				
MWM-02A	17-May-16	349.80	344.05	0.36	-4.17	-0.086	Up
MWM-02B	17-May-16	349.44	348.22				
MWM-02A	5-Aug-16	349.76	344.05	0.41	-4.17	-0.098	Up
MWM-02B	5-Aug-16	349.35	348.22				
MWM-02A	6-Oct-16	349.76	344.05	0.48	-4.17	-0.115	Up
MWM-02B	6-Oct-16	349.28	348.22				
MWM-02A	19-Jun-17	349.87	344.05	0.17	-4.17	-0.041	Up
MWM-02B	1-Jun-17	349.70	348.22				
MWM-02A	4-Oct-17	349.39	344.05	0.46	-4.17	-0.110	Up
MWM-02B	4-Oct-17	348.93	348.22				
MWM-02A	23-Jun-18	350.13	344.05	0.62	-4.17	-0.149	Up
MWM-02B	23-Jun-18	349.51	348.22				
MWM-02A	22-Aug-18	349.54	344.05	0.53	-4.17	-0.127	Up
MWM-02B	22-Aug-18	349.01	348.22				
MWM-02A	27-Jun-19	350.24	344.05	0.69	-4.17	-0.166	Up
MWM-02B	27-Jun-19	349.55	348.22				
MWM-05A	24-Jul-15	332.06	314.46	0.34	-6.35	-0.053	Up
MWM-05B	24-Jul-15	331.72	320.81				
MWM-05A	29-Jul-15	332.03	314.46	0.05	-6.35	-0.008	Up
MWM-05B	29-Jul-15	331.98	320.81				
MWM-05A	22-Sep-15	332.12	314.46	0.06	-6.35	-0.009	Up
MWM-05B	22-Sep-15	332.06	320.81				
MWM-05A	15-May-16	331.95	314.46	0.05	-6.35	-0.008	Up
MWM-05B	15-May-16	331.90	320.81				
MWM-05A	3-Aug-16	332.41	314.46	0.05	-6.35	-0.008	Up
MWM-05B	3-Aug-16	332.36	320.81				
MWM-05A	1-Oct-16	332.40	314.46	0.02	-6.35	-0.003	Up
MWM-05B	1-Oct-16	332.38	320.81				
MWM-05A	15-Jun-17	332.87	314.46	0.18	-6.35	-0.028	Up
MWM-05B	15-Jun-17	332.69	320.81				

Table 3B
Summary of Vertical Hydraulic Gradients, MacLellan Site
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Well ID	Water Level Date	Groundwater Elevation m AMSL	Screen Mid Point m AMSL	dl m	dh m	i m/m	Flow Direction
MWM-05A	9-Aug-17	332.54	314.46	0.15	-6.35	-0.023	Up
MWM-05B	9-Aug-17	332.39	320.81				
MWM-05A	5-Oct-17	332.16	314.46	0.11	-6.35	-0.017	Up
MWM-05B	5-Oct-17	332.05	320.81				
MWM-05A	23-Jun-18	332.34	314.46	0.32	-6.35	-0.050	Up
MWM-05B	23-Jun-18	332.02	320.81				
MWM-05A	20-Aug-18	332.37	314.46	0.18	-6.35	-0.028	Up
MWM-05B	20-Aug-18	332.19	320.81				
MWM-05A	17-Oct-18	332.50	314.46	0.08	-6.35	-0.012	Up
MWM-05B	17-Oct-18	332.42	320.81				
MWM-05A	30-Jun-19	332.53	314.46	0.15	-6.35	-0.023	Up
MWM-05B	30-Jun-19	332.38	320.81				
MWM-06A	23-Jul-15	331.39	326.11	-0.12	-3.44	0.034	Down
MWM-06B	23-Jul-15	331.51	329.55				
MWM-06A	29-Jul-15	331.44	326.11	-0.08	-3.44	0.023	Down
MWM-06B	29-Jul-15	331.52	329.55				
MWM-06A	22-Sep-15	331.25	326.11	-0.09	-3.44	0.026	Down
MWM-06B	22-Sep-15	331.34	329.55				
MWM-06A	14-May-16	331.24	326.11	-0.08	-3.44	0.023	Down
MWM-06B	14-May-16	331.32	329.55				
MWM-06A	3-Aug-16	331.44	326.11	-0.12	-3.44	0.035	Down
MWM-06B	3-Aug-16	331.56	329.55				
MWM-06A	1-Oct-16	331.61	326.11	-0.13	-3.44	0.037	Down
MWM-06B	1-Oct-16	331.74	329.55				
MWM-09A	29-Jul-15	339.24	334.85	0.14	-3.67	-0.038	Up
MWM-09B	29-Jul-15	339.10	338.53				
MWM-09A	31-Jul-15	339.37	334.85	0.00	-3.67	0.000	Down
MWM-09B	31-Jul-15	339.37	338.53				
MWM-09A	22-Sep-15	338.80	334.85	0.05	-3.67	-0.015	Up
MWM-09B	22-Sep-15	338.74	338.53				
MWM-09A	15-May-16	339.20	334.85	-0.01	-3.67	0.002	Down
MWM-09B	15-May-16	339.20	338.53				
MWM-09A	3-Aug-16	339.34	334.85	-0.05	-3.67	0.013	Down
MWM-09B	3-Aug-16	339.38	338.53				
MWM-09A	1-Oct-16	339.16	334.85	-0.02	-3.67	0.004	Down
MWM-09B	1-Oct-16	339.17	338.53				
MWM-09A	7-Jun-17	341.29	334.85	-0.07	-3.67	0.018	Down
MWM-09B	7-Jun-17	341.35	338.53				
MWM-09A	8-Aug-17	339.99	334.85	4.63	-3.67	-1.262	Up
MWM-09B	8-Aug-17	335.35	338.53				
MWM-09A	2-Oct-17	339.03	334.85	0.00	-3.67	-0.001	Up
MWM-09B	2-Oct-17	339.02	338.53				
MWM-09A	23-Jun-18	340.22	334.85	1.18	-3.67	-0.322	Up
MWM-09B	23-Jun-18	339.03	338.53				

Table 3B
Summary of Vertical Hydraulic Gradients, MacLellan Site
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Well ID	Water Level Date	Groundwater Elevation m AMSL	Screen Mid Point m AMSL	dl m	dh m	i m/m	Flow Direction
MWM-09A	23-Aug-18	339.31	334.85	-0.06	-3.67	0.015	Down
MWM-09B	23-Aug-18	339.36	338.53				
MWM-09A	17-Oct-18	339.80	334.85	-0.07	-3.67	0.018	Down
MWM-09B	17-Oct-18	339.86	338.53				
MWM-09A	26-Jun-19	339.94	334.85	-0.38	-3.67	0.102	Down
MWM-09B	26-Jun-19	340.31	338.53				
MWM-10A	23-Jul-15	326.12	315.80	0.03	-4.90	-0.005	Up
MWM-10B	23-Jul-15	326.09	320.69				
MWM-10A	29-Jul-15	326.25	315.80	0.02	-4.90	-0.003	Up
MWM-10B	29-Jul-15	326.23	320.69				
MWM-10A	23-Sep-15	326.13	315.80	0.10	-4.90	-0.020	Up
MWM-10B	23-Sep-15	326.03	320.69				
MWM-10A	4-Aug-16	326.30	315.80	0.30	-4.90	-0.060	Up
MWM-10B	4-Aug-16	326.00	320.69				
MWM-10A	7-Oct-16	326.14	315.80	0.17	-4.90	-0.034	Up
MWM-10B	7-Oct-16	325.97	320.69				
MWM-10A	15-Jun-17	326.51	315.80	0.30	-4.90	-0.060	Up
MWM-10B	15-Jun-17	326.21	320.69				
MWM-10A	9-Aug-17	324.69	315.80	-1.22	-4.90	0.250	Down
MWM-10B	9-Aug-17	325.91	320.69				
MWM-10A	4-Oct-17	326.07	315.80	0.29	-4.90	-0.058	Up
MWM-10B	4-Oct-17	325.78	320.69				
MWM-10A	22-Jun-18	326.34	315.80	0.88	-4.90	-0.179	Up
MWM-10B	22-Jun-18	325.46	320.69				
MWM-10A	20-Aug-18	326.18	315.80	-0.25	-4.90	0.052	Down
MWM-10B	20-Aug-18	326.43	320.69				
MWM-10A	30-Jun-19	326.77	315.80	0.57	-4.90	-0.116	Up
MWM-10B	30-Jun-19	326.20	320.69				
MWM-13D	4-Jul-19	348.32	337.67	0.66	-4.77	-0.138	Up
MWM-13S	4-Jul-19	347.66	342.44				
DPM-01	23-Sep-15	336.50	334.785	0.07	-1.67	-0.045	Up
DPM-01 SW	23-Sep-15	336.42	336.46				
DPM-01	17-May-16	336.49	334.785	0.02	-1.67	-0.012	Up
DPM-01 SW	17-May-16	336.47	336.46				
DPM-01	5-Aug-16	336.53	334.785	0.00	-1.67	0.000	Down
DPM-01 SW	5-Aug-16	336.53	336.46				
DPM-01	19-Jun-17	336.53	334.785	0.00	-1.67	0.000	Down
DPM-01 SW	19-Jun-17	336.53	336.46				
DPM-01	9-Aug-17	336.51	334.785	-0.02	-1.67	0.012	Down
DPM-01 SW	9-Aug-17	336.53	336.46				
DPM-01	4-Oct-17	336.47	334.785	0.01	-1.67	-0.006	Up
DPM-01 SW	4-Oct-17	336.46	336.46				

Table 3B
Summary of Vertical Hydraulic Gradients, MacLellan Site
Lynn Lake Gold Project (LLGP)
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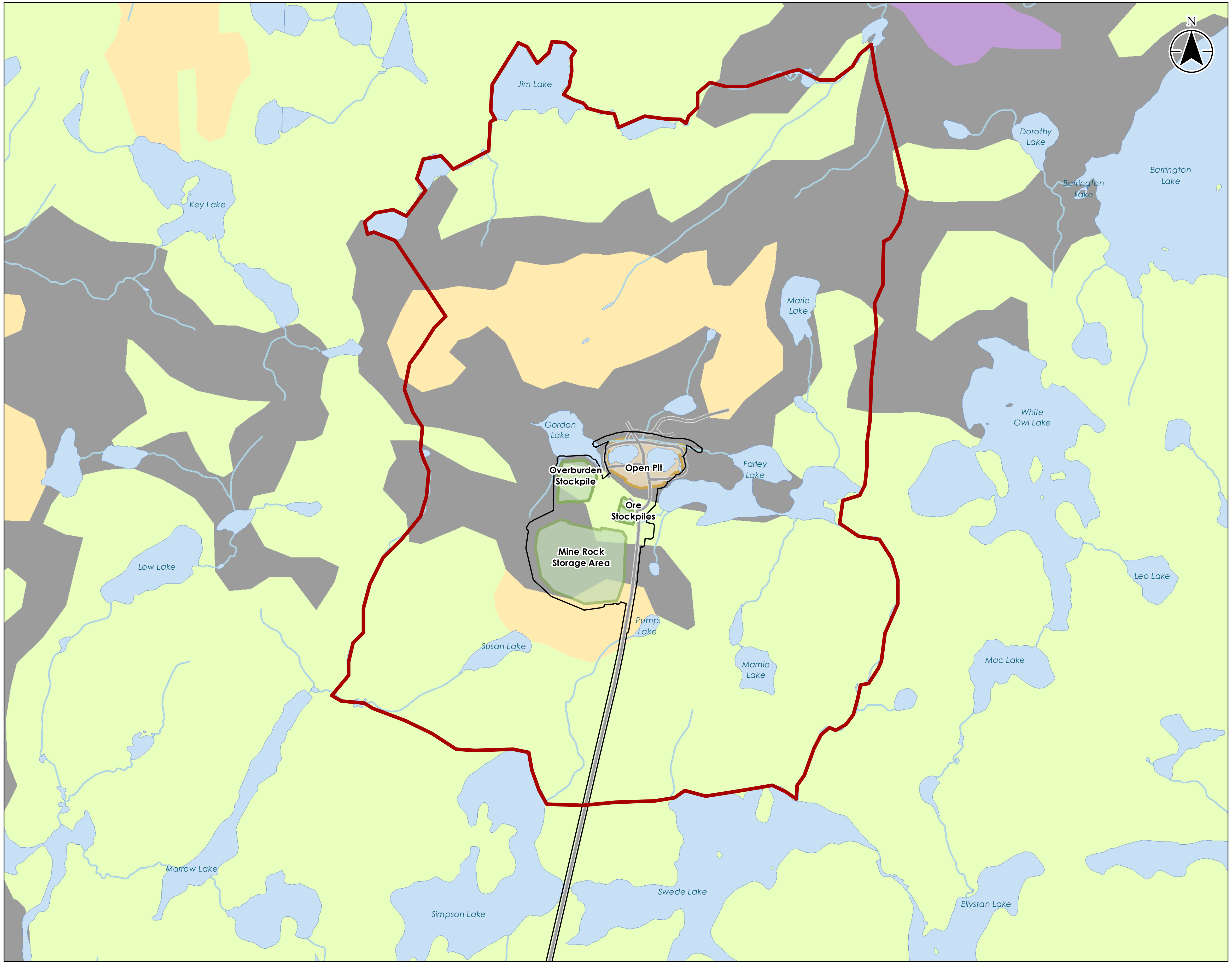
Well ID	Water Level Date	Groundwater Elevation m AMSL	Screen Mid Point m AMSL	dl m	dh m	i m/m	Flow Direction
DPM-01	23-Jun-18	336.51	334.785	0.02	-1.67	-0.012	Up
DPM-01 SW	23-Jun-18	336.49	336.46				
DPM-01	22-Aug-18	336.48	334.785	0.00	-1.67	0.000	Down
DPM-01 SW	22-Aug-18	336.48	336.46				
DPM-01	20-Oct-18	336.53	334.785	-0.09	-1.67	0.054	Down
DPM-01 SW	20-Oct-18	336.62	336.46				
DPM-01	8-Jul-19	336.45	334.785	0.00	-1.67	0.000	Down
DPM-01 SW	8-Jul-19	336.45	336.46				
DPM-02	28-Jul-15	332.07	331.21	0.02	-0.66	-0.024	Up
DPM-02 SW	28-Jul-15	332.05	331.87				
DPM-02	28-Sep-15	332.88	331.21	0.98	-0.66	-1.481	Up
DPM-02 SW	28-Sep-15	331.90	331.87				
DPM-02	15-May-16	332.13	331.21	-0.09	-0.66	0.143	Down
DPM-02 SW	15-May-16	332.22	331.87				
DPM-02	15-Jun-17	332.68	331.21	0.90	-0.66	-1.360	Up
DPM-02 SW	15-Jun-17	331.78	331.87				
DPM-02	9-Aug-17	332.15	331.21	-0.12	-0.66	0.188	Down
DPM-02 SW	9-Aug-17	332.27	331.87				
DPM-02	4-Oct-17	331.83	331.21	-0.04	-0.66	0.067	Down
DPM-02 SW	4-Oct-17	331.87	331.87				
DPM-02	24-Jun-18	332.19	331.21	-0.16	-0.66	0.249	Down
DPM-02 SW	24-Jun-18	332.35	331.87				
DPM-02	22-Aug-18	332.07	331.21	-0.18	-0.66	0.279	Down
DPM-02 SW	22-Aug-18	332.25	331.87				
DPM-02	15-Oct-18	332.19	331.21	-0.27	-0.66	0.416	Down
DPM-02 SW	15-Oct-18	332.46	331.87				
DPM-02	27-Jun-19	332.29	331.21	-0.48	-0.66	0.734	Down
DPM-02 SW	27-Jun-19	332.77	331.87				
DPM-03	28-Jul-15	329.74	328.39	0.01	-1.10	-0.008	Up
DPM-03 SW	28-Jul-15	329.73	329.49				
DPM-03	28-Sep-15	329.35	328.39	-0.29	-1.10	0.266	Down
DPM-03 SW	28-Sep-15	329.64	329.49				
DPM-03	15-May-16	329.43	328.39	-0.24	-1.10	0.220	Down
DPM-03 SW	15-May-16	329.67	329.49				
DPM-03	3-Aug-16	329.49	328.39	0.93	-1.10	-0.848	Up
DPM-03 SW	3-Aug-16	328.56	329.49				
DPM-04	29-Jul-15	326.14	325.27	0.23	-0.49	-0.465	Up
DPM-04 SW	29-Jul-15	325.91	325.75				
DPM-04	28-Sep-15	326.22	325.27	0.76	-0.49	-1.551	Up
DPM-04 SW	28-Sep-15	325.46	325.75				
DPM-04	3-Oct-17	325.81	325.27	0.45	-0.49	-0.916	Up
DPM-04 SW	3-Oct-17	325.36	325.75				

Table 3B
Summary of Vertical Hydraulic Gradients, MacLellan Site
Lynn Lake Gold Project (LLGP)
Hydrogeology Baseline Technical Data Report

Well ID	Water Level Date	Groundwater Elevation m AMSL	Screen Mid Point m AMSL	dl m	dh m	i m/m	Flow Direction
DPM-04	22-Jun-18	325.96	325.27	0.35	-0.49	-0.711	Up
DPM-04 SW	22-Jun-18	325.61	325.75				
DPM-04	20-Aug-18	326.01	325.27	0.56	-0.49	-1.141	Up
DPM-04 SW	20-Aug-18	325.45	325.75				
DPM-04	17-Oct-18	327.03	325.27	1.31	-0.49	-2.678	Up
DPM-04 SW	17-Oct-18	325.72	325.75				
DPM-04	30-Jun-19	326.03	325.27	0.25	-0.49	-0.506	Up
DPM-04 SW	30-Jun-19	325.78	325.75				
DPM-05	31-Jul-15	333.47	331.895	0.00	-1.91	-0.001	Up
DPM-05 SW	31-Jul-15	333.47	333.8				
DPM-05	18-May-16	333.59	331.895	0.00	-1.91	0.000	Down
DPM-05 SW	18-May-16	333.59	333.8				
DPM-05	5-Aug-16	333.48	331.895	-0.17	-1.91	0.089	Down
DPM-05 SW	5-Aug-16	333.65	333.8				
DPM-05	20-Jun-17	333.55	331.895	-0.04	-1.91	0.021	Down
DPM-05 SW	20-Jun-17	333.59	333.8				
DPM-05	8-Aug-17	333.55	331.895	-0.14	-1.91	0.073	Down
DPM-05 SW	8-Aug-17	333.69	333.8				
DPM-05	3-Oct-17	333.58	331.895	-0.07	-1.91	0.037	Down
DPM-05 SW	3-Oct-17	333.65	333.8				
DPM-05	24-Jun-18	333.60	331.895	-0.15	-1.91	0.079	Down
DPM-05 SW	24-Jun-18	333.75	333.8				
DPM-05	22-Aug-18	333.61	331.895	-0.07	-1.91	0.037	Down
DPM-05 SW	22-Aug-18	333.68	333.8				
DPM-05	16-Oct-18	333.79	331.895	0.07	-1.91	-0.037	Up
DPM-05 SW	16-Oct-18	333.72	333.8				
DPM-05	26-Jun-19	333.67	331.895	-0.16	-1.91	0.084	Down
DPM-05 SW	26-Jun-19	333.83	333.8				

A.5 ATTACHMENT IAAC-69



Stantec

Project Infrastructure

☐ Project Development

🟧 Proposed Open Pit

🟩 Potential Infrastructure

Study Area

🟥 Local Study Area

Surficial Geology

⬛ Organic Deposits

🟨 Marginal Glaciolacustrine Sediments

🟩 Sand Diamicton

🟪 Precambrian Terrane

Landbase

— Existing Access Road

— Watercourse

🟦 Waterbody

0 0.5 1 Kilometres

1:40,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base features provided by the Government of Manitoba and the Government of Canada.

Project Location
Gordon Site
Lynn Lake, Manitoba

111473000

Prepared by AC on 2021-01-25
Technical Review by MF on 2021-01-25

Client/Project

LYNN LAKE GOLD PROJECT
ENVIRONMENTAL BASELINE STUDIES

Map No.

IAAC-69-1

Title

Surficial Geology - Gordon

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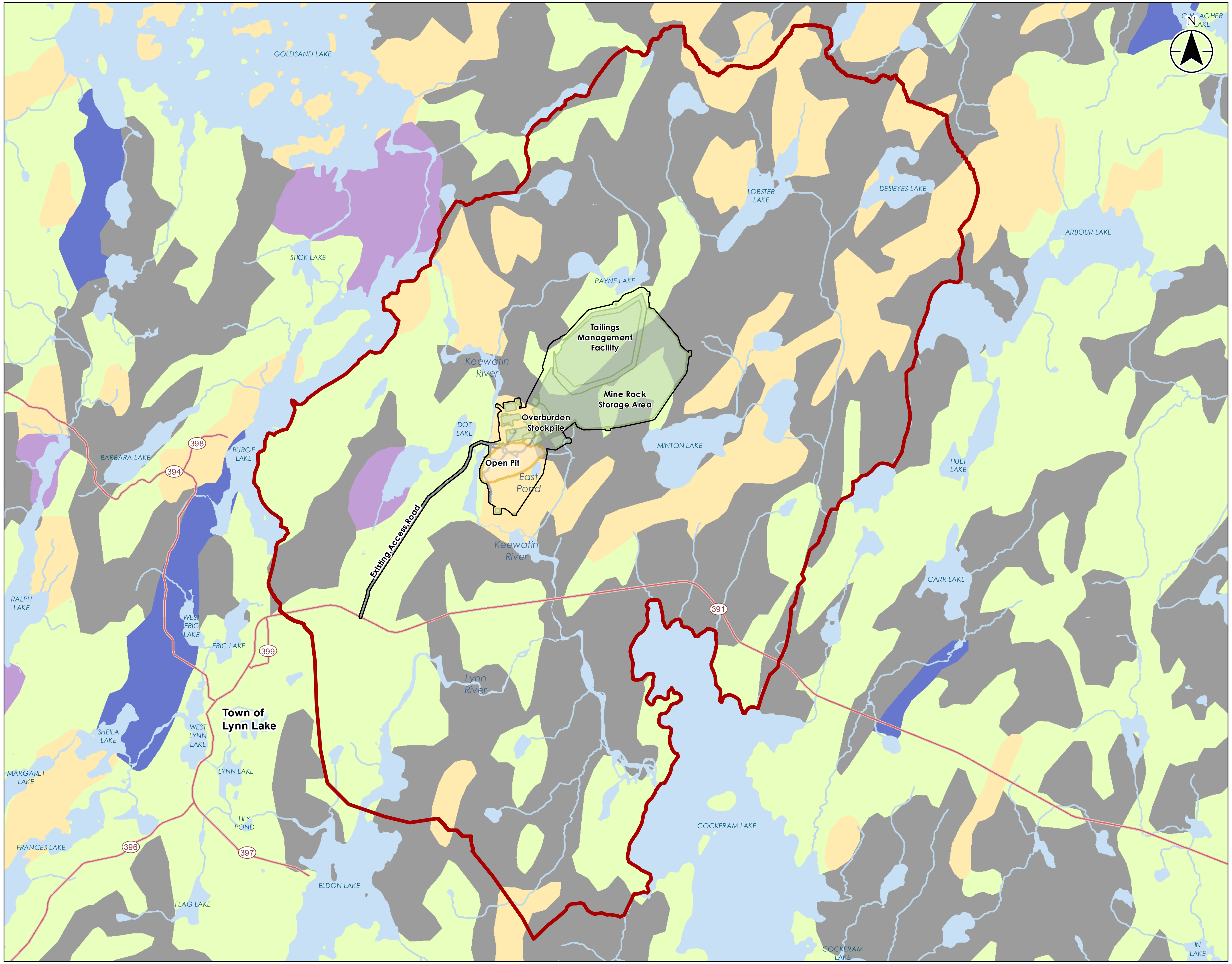

Stantec

Project Infrastructure

☐ Project Development Area

🟨 Proposed Open Pit

🟩 Potential Infrastructure

— Existing Access Road

Study Area

🟥 Study Area

Landbase

— Highway

— Existing Access Road

🟦 Waterbody

Surficial Geology

⬛ Organic Deposits

🟨 Marginal Glaciolacustrine Sediments

🟦 Proximal Glaciofluvial Sediments

🟩 Sand Diamicton

🟪 Precambrian Terrane

0 1 2 Kilometres

1:80,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base features provided by the Government of Manitoba and the Government of Canada.

Project Location
MacLellan Site
Lynn Lake, Manitoba

111473000

Prepared by AC on 2021-01-25
Technical Review by MF on 2021-01-25

Client/Project

ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.

IAAC-69-2

Title

Surficial Geology - MacLellan

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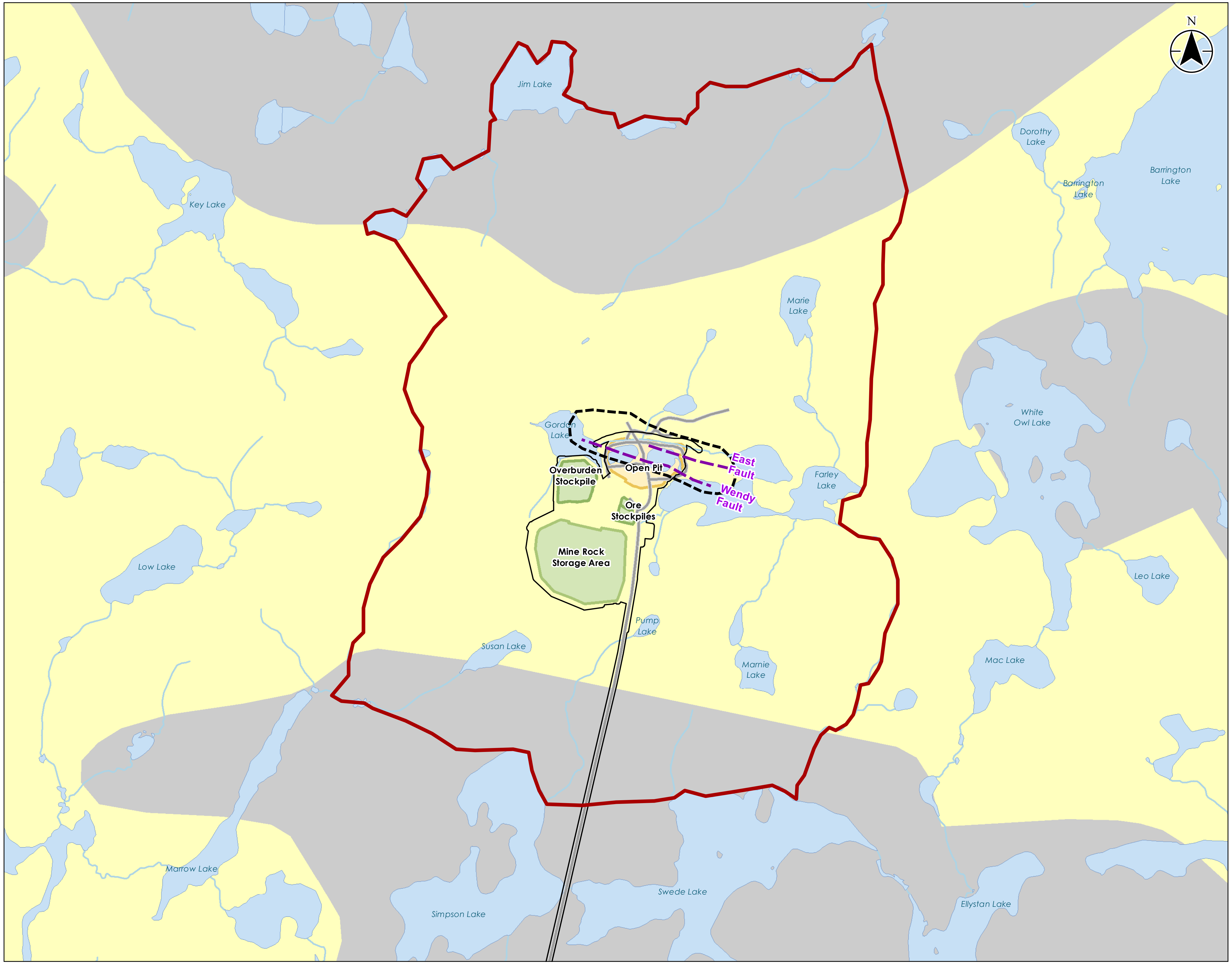

Stantec

Project Infrastructure

☐ Project Development Area

▨ Proposed Open Pit

🟩 Potential Infrastructure

Study Area

🟥 Local Study Area

⬚ Faulted Shallow bedrock zone in groundwater flow model

Bedrock Geology

▨ Intrusive Rocks

▨ Metavolcanic Rocks (includes Amisk and Wasekwan Groups and Great Island volcanic rocks)

Landbase

- - Approximate Location of Fault

— Existing Access Road

— Watercourse

▨ Waterbody

0 0.5 1 Kilometres

1:40,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base features provided by the Government of Manitoba and the Government of Canada.

Project Location
Gordon Site
Lynn Lake, Manitoba

111473000

Prepared by AC on 2021-01-25
Technical Review by MF on 2021-01-25

Client/Project

ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.

IAAC-69-3

Title

Bedrock Geology - Gordon

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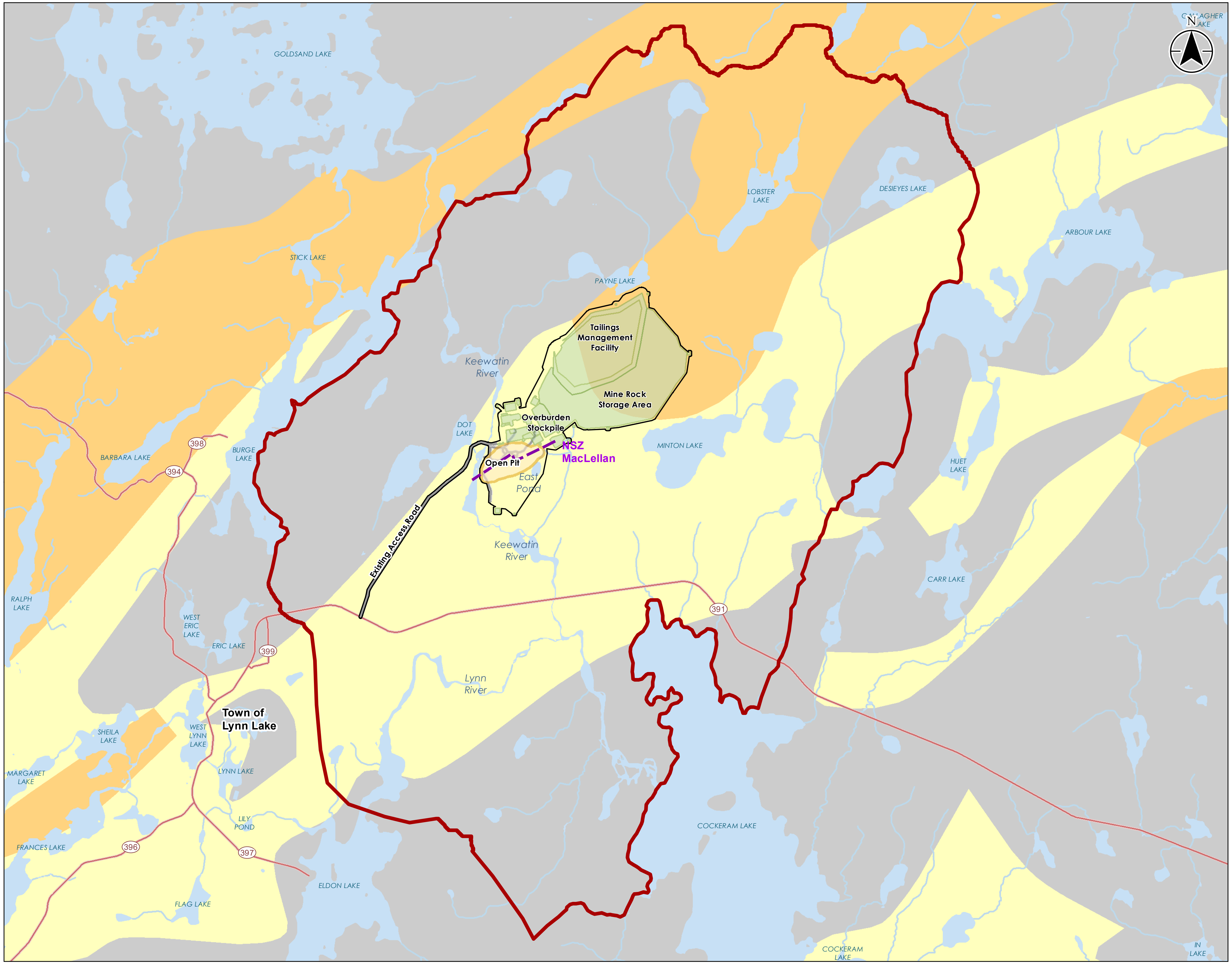

Stantec

Project Infrastructure

☐	Project Development Area
▨	Proposed Open Pit
🟩	Potential Infrastructure
—	Existing Access Road

Study Area

🟥	Study Area

Bedrock Geology

▨	Intrusive Rocks
🟧	Metamorphic and Metasedimentary Rocks
🟨	Metavolcanic Rocks (includes Amisk and Wasekwan Groups and Great Island volcanic rocks)

Landbase

– –	Approximate Location of Fault
—	Highway
—	Existing Access Road
🟦	Waterbody

0 1 2 Kilometres

1:80,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base features provided by the Government of Manitoba and the Government of Canada.

Project Location
MacLellan Site
Lynn Lake, Manitoba

111473000
Prepared by AC on 2021-01-25
Technical Review by MF on 2021-01-25

Client/Project

ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.

IAAC-69-4

Title

Bedrock Geology - MacLellan

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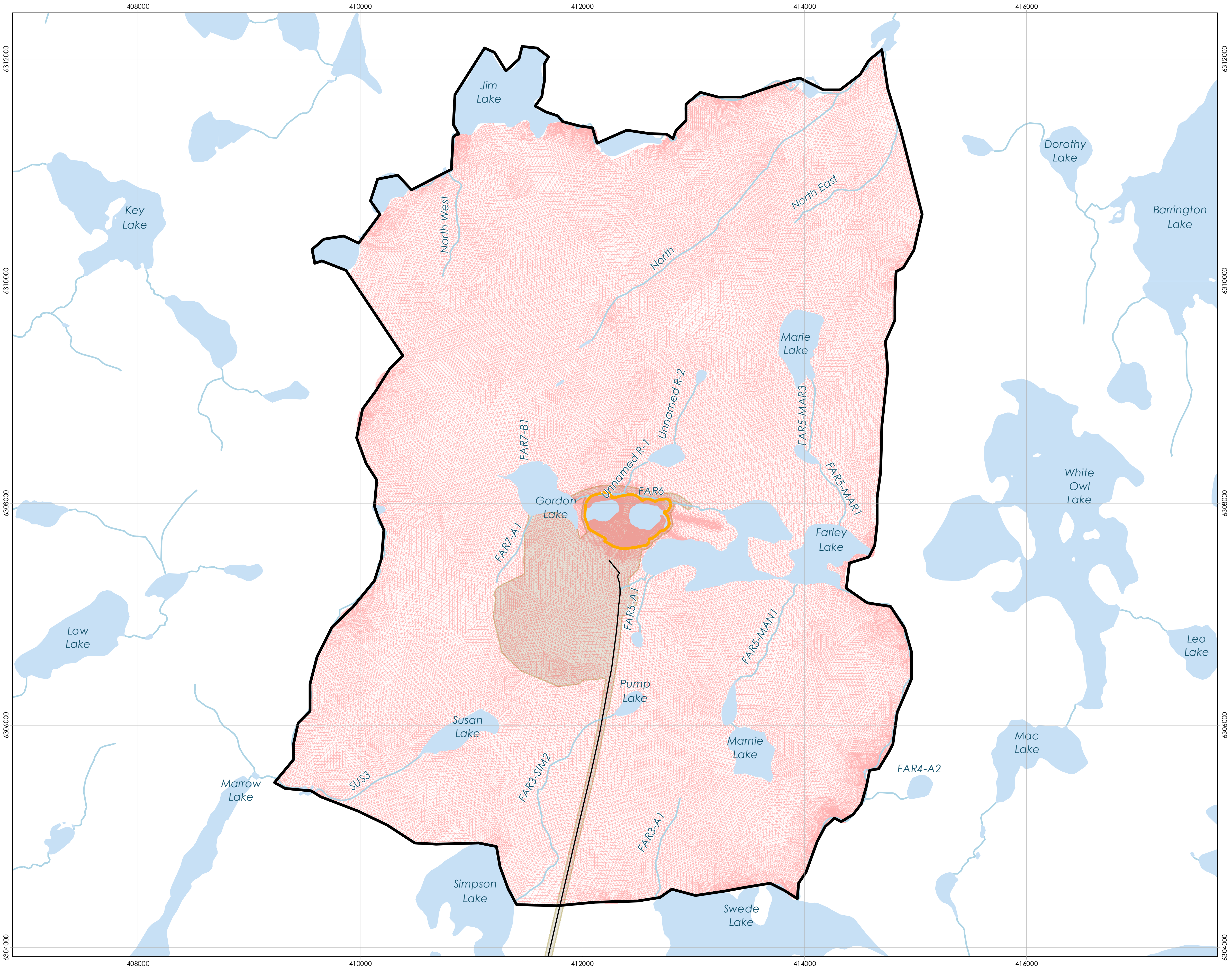
A.6 ATTACHMENT IAAC-72



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Stantec

Project Infrastructure

- ▭ Proposed Open Pit
- ▨ Project Development Area

Study Area

- ▭ Groundwater Local Assessment Area (LAA) and Regional Assessment Area (RAA)
- ▭ Model Mesh

Landbase

- — Existing Access
- — Watercourse
- ▨ Waterbody

N

0 0.5 1 Kilometre

(At original document size of 11x17)
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Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada.

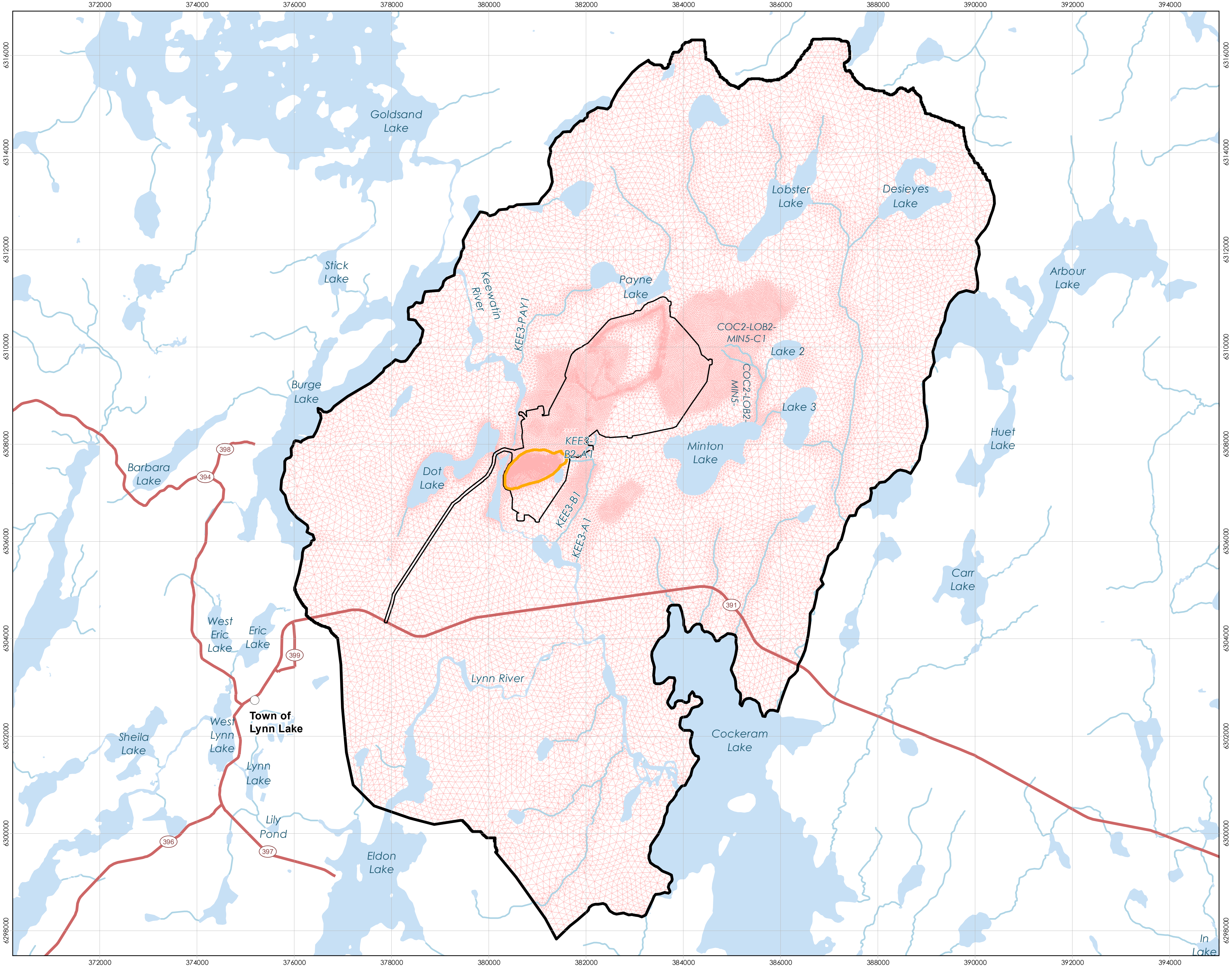
Project Location
Lynn Lake,
Manitoba

Prepared by ACampigotto on 2021-01-26
Technical Review by MFraser on 2021-01-26

Client/Project
111473008
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-72-1

Title
Model Domain and Boundary Conditions - Gordon



Stantec

Project Infrastructure

🟨 Proposed Open Pit

☐ Project Development Area

Study Area

☐ Groundwater Local Assessment Area (LAA) and Regional Assessment Area (RAA)

☐ Model Mesh

Landbase

— Highway

— Watercourse

▨ Waterbody

N

0 1 2 Kilometres

(At original document size of 11x17)
1:80,000

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N

2. Base Data Sources: Government of Manitoba and Government of Canada.

Project Location
Lynn Lake,
Manitoba

Prepared by ACampigotto on 2021-05-27
Technical Review by MFraser on 2021-05-27

Client/Project
ALAMOS GOLD INC.
Lynn Lake Gold Project

111473008

Map No.
IAAC-72-2

Title
Model Domain and Boundary Conditions - MacLellan

G:_GIS_Project_Folder\111473008_LLGP_EA\IRs\Hydro-Geology\IAAC-72\Map_IAAC-72-2_ModelDomain_Maclellan_20210527.mxd Revised: 2021-05-27 By: ACampigotto

Table IAAC-72-1a Assigned Head Values of Lakes and Rivers in the Groundwater Flow Models

Gordon Site	
Surface Water Feature	**Head (m amsl)**
Gordon Lake	314.84
Farley Lake	312.78
Marnie Lake	319.64
Marie Lake	336.99
Pump Lake	325.31
Susan Lake	310.90
Jim Lake	-
SUS3	307.17
FAR3-SIM2	311.00
FAR3-A1	305.40
FAR7-A1	320.26
FAR5-A1	318.25
FAR5-MAN1	317.61
FAR7-B1	323.30
Unnamed R-1	316.38
Unnamed R-2	323.45
FAR5-MAR1	318.37
FAR5-MAR3	326.39
North West	311.65
North	317.00
North East	305.50

MacLellan Site	
Surface Water Feature	**Head (m amsl)**
Minton Lake	328.93
Dot Lake	330.78
Payne Lake	347.72
Lobster Lake	342.08
Desieyes Lake	338.65
Lake 2	335.95
Lake 3	328.58
Keewatin river	327.26
Lynn River	327.97
KEE3-A1	326.7
KEE3-B1	325.78
KEE3-PAY1	342.5
Kee3-B2-A1	328.62
COC2-LOB2-MIN5-C1	341.32
COC2-LOB2-MIN5	338.7

Notes:
amsl: above mean sea level

Table IAAC-72-1b Assigned Boundary Conditions in the Groundwater Flow Models

Site	Lake	Type of Boundary Condition	Value (m amsl)
Gordon	Swede lake	Constant Head	314.25
	Simpson lake	Constant Head	314.25
	Jim lake	Constant Head	307.58*
MacLellan	Cockeram Lake	Transfer	312.17**
	Burge Lake	Transfer	342.56**
	Eldon Lake	Transfer	328.018**
	Arbour lake	Transfer	323.54**

Notes:

amsl: above mean sea level

*: The head varies along the surface water feature, the boundary condition is set as the surface water elevation. The value presented in the table is the average along the shoreline of Jim Lake.

**: The head varies along the surface water feature, the boundary condition value represents the surface water elevation minus 0.01 m. The value presented in the table is the average of the boundary condition for the specific water body.

A.7 ATTACHMENT IAAC-73

Table IAAC-73-1: MacLellan Site - Water Level Calibration Residuals and Statistics (updated from Table 4-2 of Volume 5, Appendix G of the EIS)

Location	Average Annual Target Water Level (m AMSL)	Simulated Average Annual Water Level (m AMSL)	Residual (m)	Target Type	Screened Material	Hydrostratigraphic Unit
MWM-01A	343.89	343.68	-0.21	Steady-state	Bedrock	Shallow Bedrock
MWM-02A	349.91	350.1	0.19	Steady-state	Bedrock	Shallow Bedrock
MWM-02B	349.48	350.03	0.55	Steady-state	Sand and Silty Sand	Glaciolacustrine Nearshore
MWM-04	349.92	342.75	-7.17	Steady-state	Bedrock	Shallow Bedrock
MWM-05A	332.16	332.72	0.56	Steady-state	Bedrock	Shallow Bedrock
MWM-05B	332.11	332.68	0.57	Steady-state	Silty Sand to Sand	Sand Diamicton
MWM-06A	331.27	331.64	0.37	Steady-state	Bedrock	Shallow Bedrock
MWM-06B	331.51	331.67	0.16	Steady-state	Sand	Glaciolacustrine Nearshore
MWM-09A	344.61	337.57	-7.04	Steady-state	Bedrock	Shallow Bedrock
MWM-09B	345.01	337.57	-7.44	Steady-state	Sand and Gravel	Glaciolacustrine Nearshore
MWM-10A	327.47	326.87	-0.6	Steady-state	Bedrock	Shallow Bedrock
MWM-10B	327.77	326.77	-1	Steady-state	Sand, Cobbles, and Boulders	Glaciolacustrine Nearshore / Glaciofluvial
GBHM-01B	333.93	334.74	0.81	Steady-state	Silty Sand	Sand Diamicton
GBHM-03A	336.46	336.6	0.14	Steady-state	Bedrock	Shallow Bedrock
GBHM-05A	330.71	331.98	1.27	Steady-state	Bedrock	Shallow Bedrock
GBHM-05B	330.7	332	1.3	Steady-state	Sand and Silt	Sand Diamicton
GBHM-06A	344.28	335.93	-8.35	Steady-state	Bedrock	Shallow Bedrock
GBHM-08	351.34	349.18	-2.16	Steady-state	Bedrock	Shallow Bedrock
GBHM-09A	346.22	343.83	-2.39	Steady-state	Bedrock	Shallow Bedrock
GBHM-10A	338.61	339.57	0.96	Steady-state	Bedrock	Shallow Bedrock
GBHM-10B	338.2	339.68	1.48	Steady-state	Silty Sand	Sand Diamicton
GBHM-12	335.64	340.14	4.5	Steady-state	Bedrock	Shallow Bedrock
GBHM-13A	343.21	343.61	0.4	Steady-state	Bedrock	Shallow Bedrock
GBHM-13B	343.21	343.5	0.29	Steady-state	Silty Clay, Silty Sand, Clayey Sand	Glaciolacustrine Offshore / Sand Diamicton

Notes:
AMSL: above mean sea level

Table IAAC-73-2: Gordon Site - Water Level Calibration Residuals and Statistics (updated from Table 4-2 of Volume 5, Appendix F of the EIS)

Location	Average Annual Target Water Level (m AMSL)	Simulated Average Annual Water Level (m AMSL)	Residual (m)	Target Type	Screened Material	Hydrostratigraphic Unit
MWF-01A	321.75	322.98	-1.23	Steady-state	Bedrock	Shallow Bedrock
MWF-02A	317.37	318.83	-1.46	Steady-state	Bedrock	Shallow Bedrock
MWF-02B	317.28	318.81	-1.53	Steady-state	Silty Sand, Boulders, Gravel	Glaciofluvial / Glaciolacustrine Nearshore
MWF-03A	325.42	325.56	-0.14	Steady-state	Bedrock	Shallow Bedrock
MWF-03B	325.44	325.63	-0.19	Steady-state	Silty Sand	Glaciolacustrine Nearshore
MWF-04A	314.06	314.99	-0.93	Steady-state	Bedrock	Shallow Bedrock
MWF-04B	313.73	314.85	-1.12	Steady-state	Sandy Clayey Silt, Silt and Sand, Boulders	Glaciolacustrine Offshore / Sand Diamicton
GBHF-01A	314.85	315.36	-0.51	Steady-state	Bedrock	Shallow Bedrock
GBHF-01B	314.85	315.38	-0.53	Steady-state	Silty Sand	Glaciolacustrine Nearshore
GBHF-02A	315.48	315.19	0.29	Steady-state	Bedrock	Shallow Bedrock
GBHF-04A	314.31	315.4	-1.09	Steady-state	Bedrock	Shallow Bedrock
GBHF-04B	314.59	315.43	-0.84	Steady-state	Gravel	Glaciolacustrine Nearshore
GBHF-05B	314.54	315.78	-1.24	Steady-state	Silty Sand	Glaciolacustrine Offshore
GBHF-07A	317.97	318.6	-0.63	Steady-state	Bedrock	Shallow Bedrock
GBHF-07B	318.08	318.59	-0.51	Steady-state	Clayey Silty Sand to Silty Sand	Sand Diamicton
GBHF-09A	317.25	317.3	-0.05	Steady-state	Bedrock	Shallow Bedrock
GBHF-09B	317.05	317.25	-0.2	Steady-state	Silty sand	Sand Diamicton
GBHF-10A	326.12	325.49	0.63	Steady-state	Bedrock	Shallow Bedrock
GBHF-12B	323.85	324.44	-0.59	Steady-state	Silty Sand	Sand Diamicton

Notes:
AMSL: above mean sea level

A.8 ATTACHMENT IAAC-78

1.0 IAAC-78: MEMORANDUM REGARDING FTM PARAMETERIZATION IN GROUNDWATER FLOW MODELS

The freezing and thawing of the open pit walls (seepage face) was simulated in the groundwater flow model for the Gordon and MacLellan sites by adjusting, monthly, the hydraulic conductivity of the seepage face nodes. The hydraulic conductivity was determined using the heat and transport functionality of FEFLOW with the Freeze Thaw Model (FTM) plugin. The FTM plug in requires air temperature, ground temperature, volumetric heat capacity, and thermal conductivity. The parameterization of the FTM plug in is as follows.

1.1 TEMPERATURE

The air temperature is a boundary condition and was defined based on mean historical air temperature data obtained from Environment and Climate Change Canada (ECCC) Lynn Lake A station 5061646. The ground temperature was altered with depth below ground surface based on the relationship provided by McKenzie et al (2007) and as presented in Figure 1.

Table 1: Monthly Air Temperature Used in FTM Plug In

Month	Temperature (°C)
January	-23
February	-25
March	-15
April	-5
May	5
June	15
July	17
August	15
September	8
October	2
November	-15
December	-17

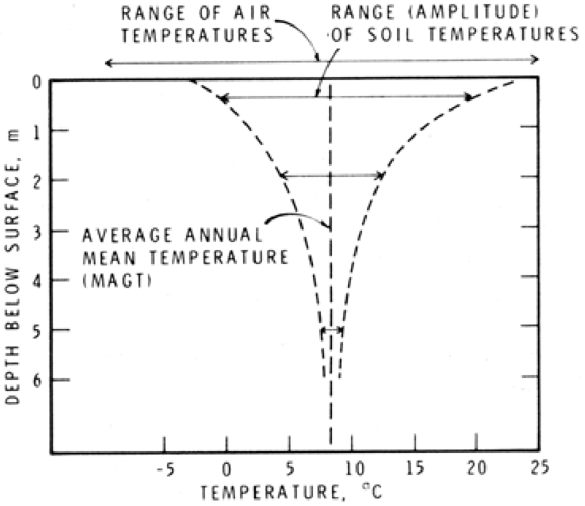


Figure 1: **Relationship of Ground Temperature with Depth (McKenzie et al 2007)**

1.2 VOLUMETRIC HEAT CAPACITY AND THERMAL CONDUCTIVITY

The fluid and solid volumetric heat capacity and thermal conductivity were applied in the model as summarized in Table 2.

Table 2: **Volumetric Heat Capacity and Thermal Conductivity**

Phase	Volumetric Heat Capacity (MJ/m^3/K)	Thermal Conductivity (J/m/s/K)
Fluid	4.2	0.65
Solid	1.94	2.22

1.3 MODELLING PROCESS

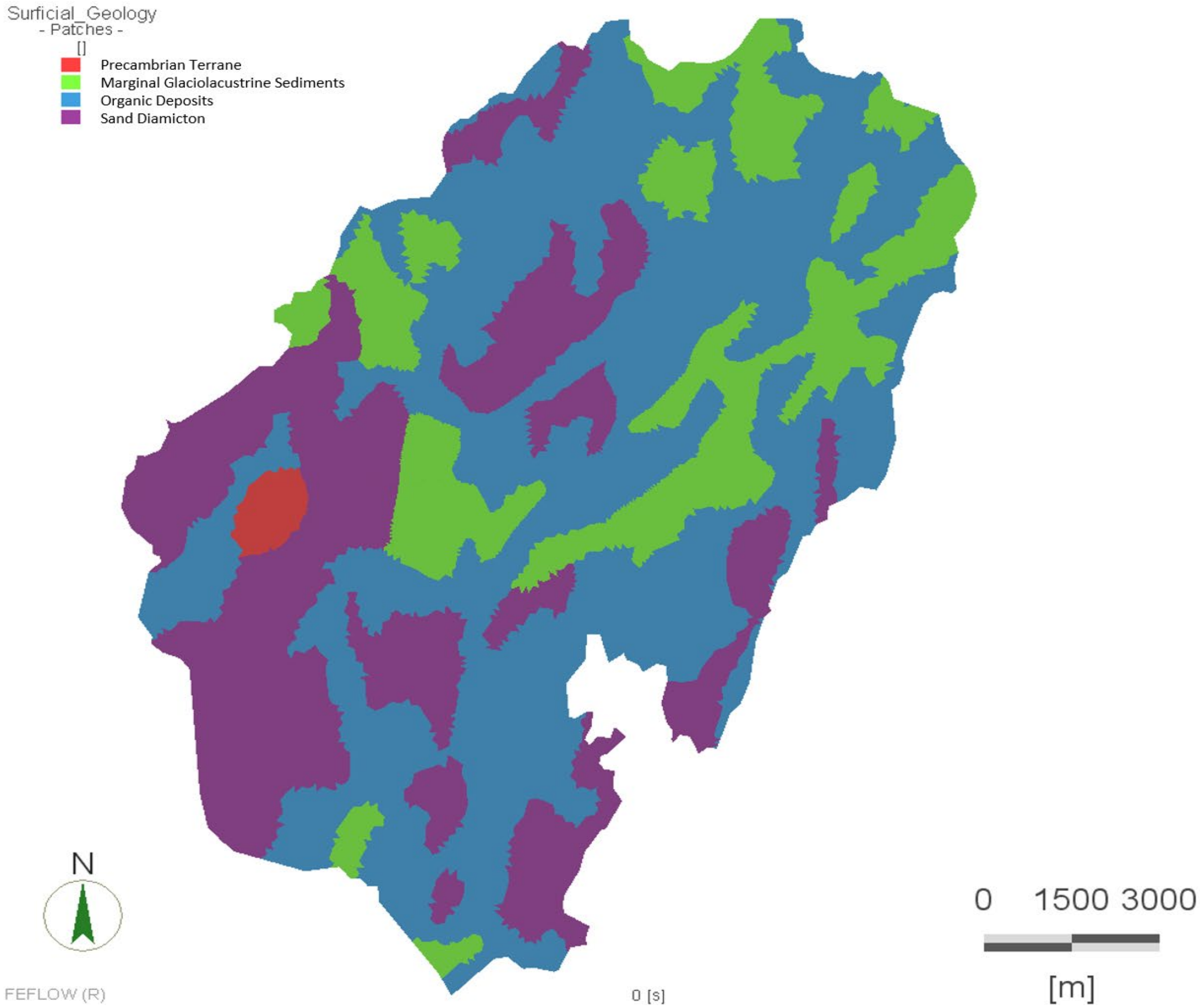
Simulations of the freezing and thawing were used to determine the changes in hydraulic conductivity predicted based on the average monthly air temperatures. Due to the additional computational burden of running the model in heat and transport mode, the simulation of effects of freezing on dewatering were conducted with only the flow components in FEFLOW, using the variable hydraulic conductivity at the pit face due to freezing as inputs that was determined using the FTM plugin.

To simplify the modelling process, time varying hydraulic conductivities were applied to the models. The surface of the model and the excavation area (open pit) were exposed to the air temperature, in these areas for freezing temperature (zero or below zero degrees Celsius), hydraulic conductivities of zero were applied.

2.0 REFERENCES

Jeffrey M. McKenzie, Clifford I. Voss, Donald I. Siegel, Groundwater flow with energy transport and water–ice phase change: Numerical simulations, benchmarks, and application to freezing in peat bogs, Advances in Water Resources, Volume 30, Issue 4, 2007, Pages 66-983, ISSN 0309-1708, ttps://doi.org/10.1016/j.advwatres.2006.08.008.

A.9 ATTACHMENT IAAC-86



Client/Project

Lynn Lake Gold Project (LLGP)

Figure No.

IAAC-86-1

Title

Groundwater Flow Model Surficial Geology - MacLellan Site

Stantec

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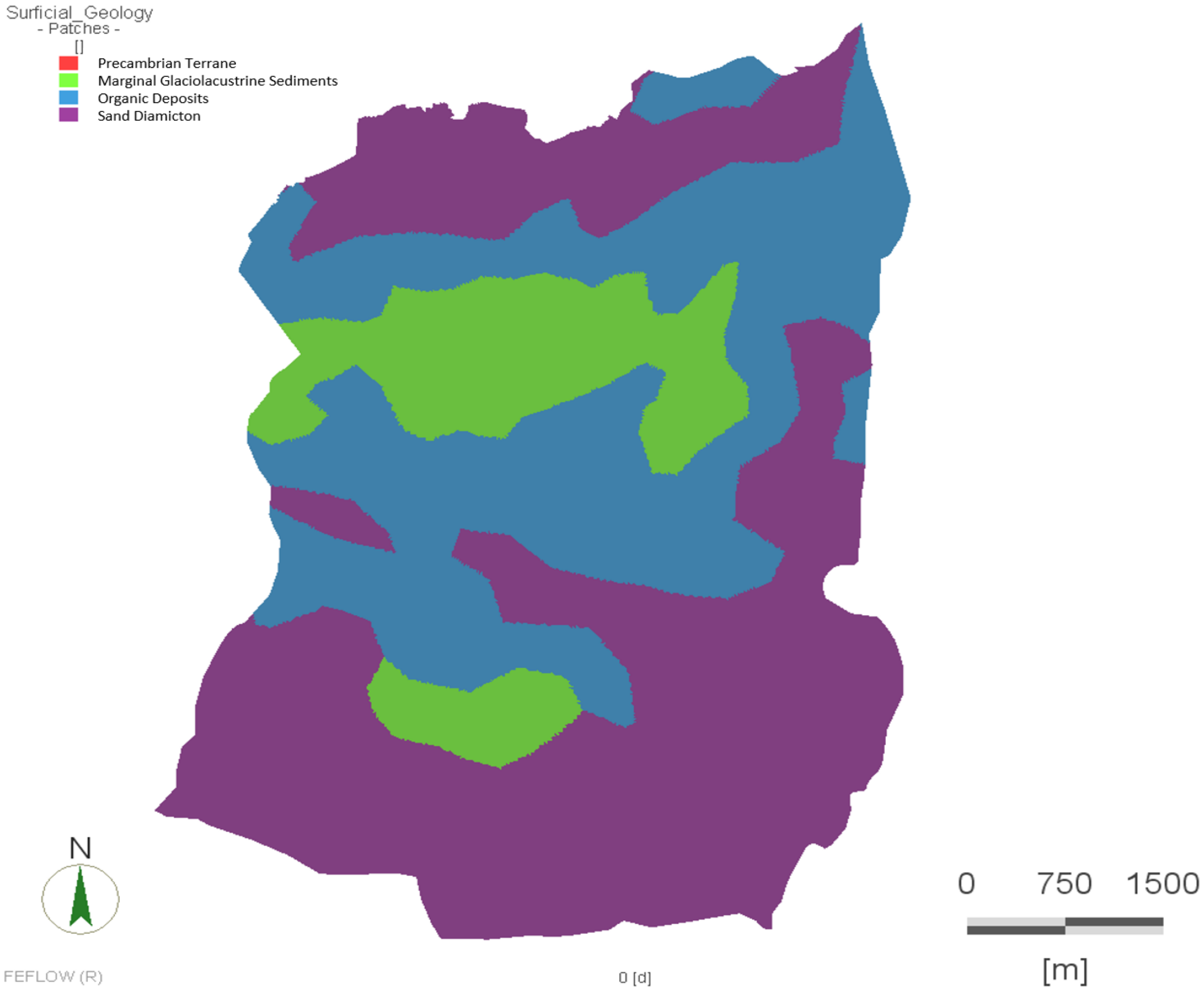


Client/Project

Lynn Lake Gold Project (LLGP)

Figure No.

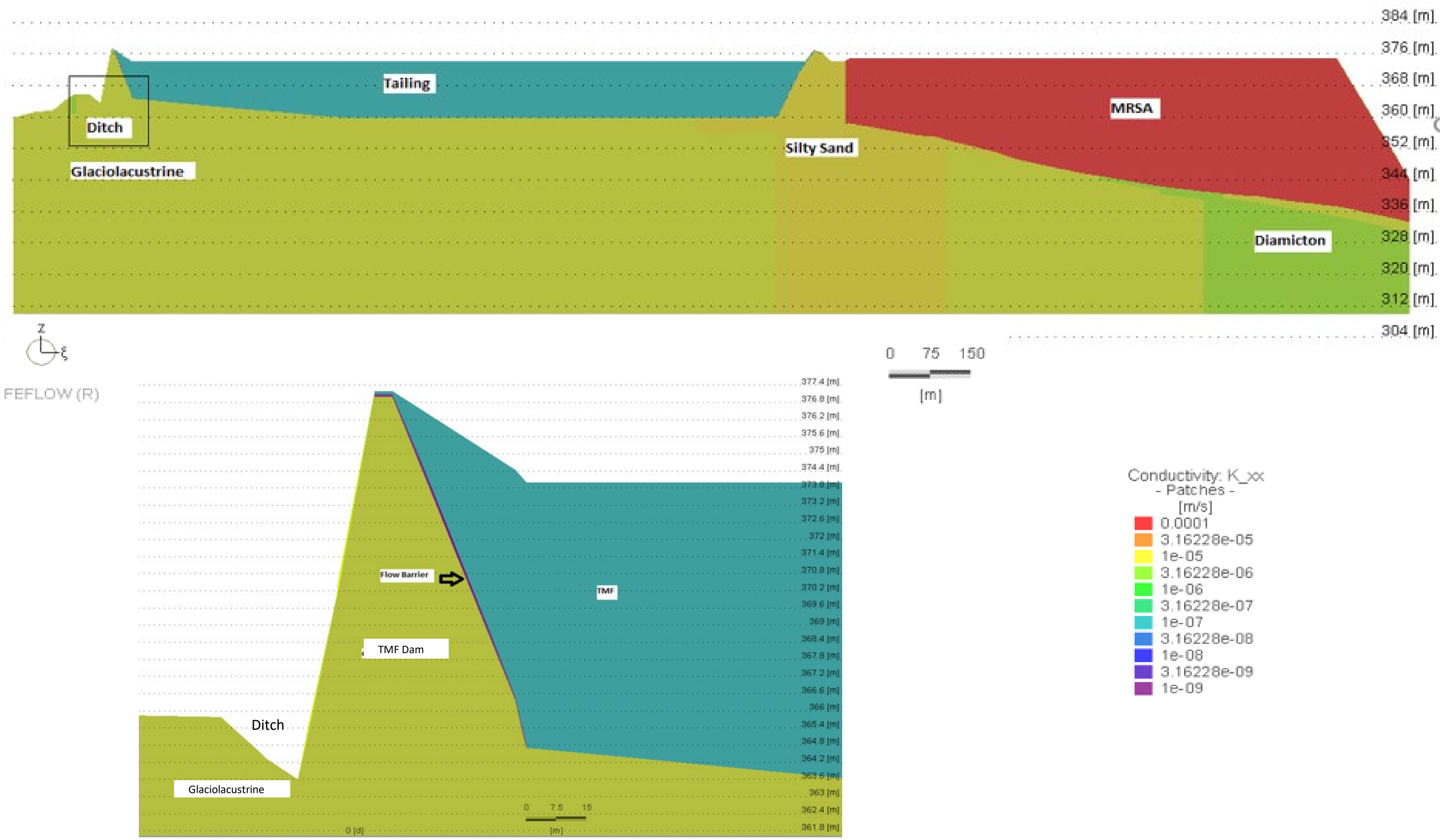
IAAC-86-2

Title

Groundwater Flow Model Surficial Geology - Gordon Site

\\cd1045-f01\workgroup\1114\Active\111473010\Round_1_IRs\Package 2\Author working files\groundwater\IAAC-86\IAAC-86-1_revised.xlsx

A.10 ATTACHMENT IAAC-87



Client/Project

Lynn Lake Gold Project (LLGP)

Figure No.

IAAC-87-1

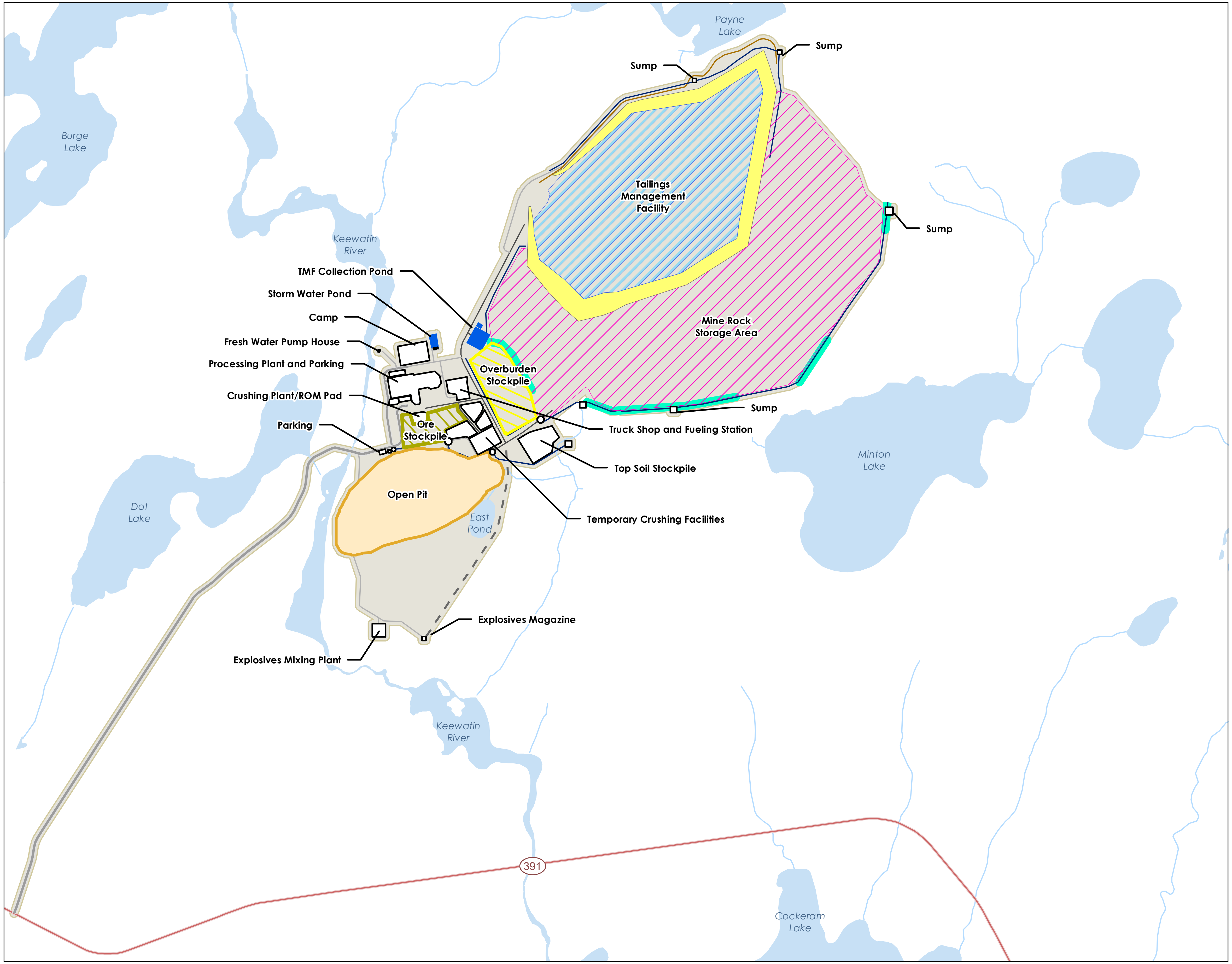
Title

Cross Section of TMF in Groundwater Flow Model

Stantec

\\cd1045-f01\workgroup\1114\Active\111473010\Round_1_IRs\Package 2\Author working files\groundwater\IAAC-87\IAAC-87-1.xlsx

A.11 ATTACHMENT IAAC-89



Stantec

Project Infrastructure

- ▭ Project Development Area
- ▭ Proposed Open Pit
- ▨ Proposed Mine Rock Stockpile
- ▨ Proposed Overburden Stockpile
- ▨ Proposed Ore Stockpile
- ▭ Proposed Tailings Management Facility
- ▨ Proposed Tailings Management Facility Pond
- ■ Other Proposed Ponds
- ☐ Other Proposed Areas
- ― Drainage Ditch
- ― Access Road
- ― Haul Road
- ― Inplant Road
- ― Toe Road
- – – Future Access Road
- ▬ Areas requiring deeper seepage collection ditches, based on seepage modelling

Landbase

- ― Highway
- ― Existing Access Road
- ― Watercourse
- ▭ Waterbody

N

0 0.5 1 Kilometres
(At original document size of 11x17)
1:30,000

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada.
3. Project Infrastructure features provided by QPit and Ausenco.
4. Borrow sources provided by Golder.

Project Location
Lynn Lake,
Manitoba

Prepared by ACampigotto on 2020-12-18
Technical Review by MFraser on 2020-12-18

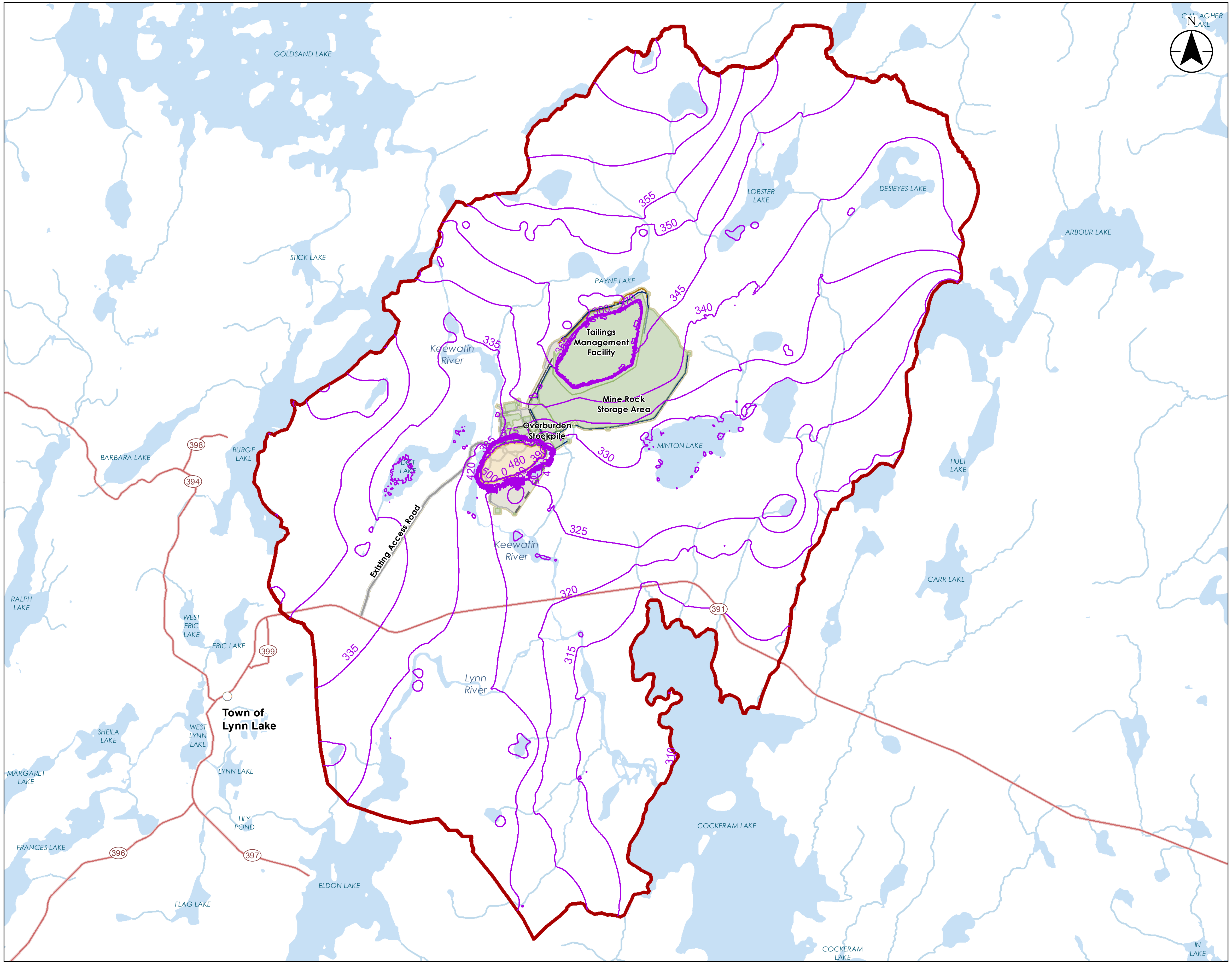
Client/Project 111473008
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-89

Title
Seepage Collection Ditch Requirements - MacLellan site

G:_GIS_Project_Folder\111473008_LLGP_EA\IRs\Contact Water Collection - GW\Map_IAAC-89_MacLellan_SeepageCollectionDitchRequirements_20210527.mxd Revised: 2021-05-27 By: ACampigotto

A.12 ATTACHMENT IAAC-90



Stantec

Project Infrastructure

- ▨ Project Development Area
- ▨ Propose Open Pit
- 🟩 Potential Infrastructure
- ― Drainage Ditch
- ― Existing Access Road
- ― Access Road
- ― Haul Road
- ― Inplant Road
- ― Toe Road
- – – Future Access Road

Study Area

- ― Water Table Elevation Contours
- ▭ Study Area

Landbase

- ― Highway
- ― Existing Access Road
- ▨ Waterbody

0 1 2 Kilometres
1:80,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base features provided by the Government of Manitoba and the Government of Canada.

Project Location
MacLellan Site
Lynn Lake, Manitoba

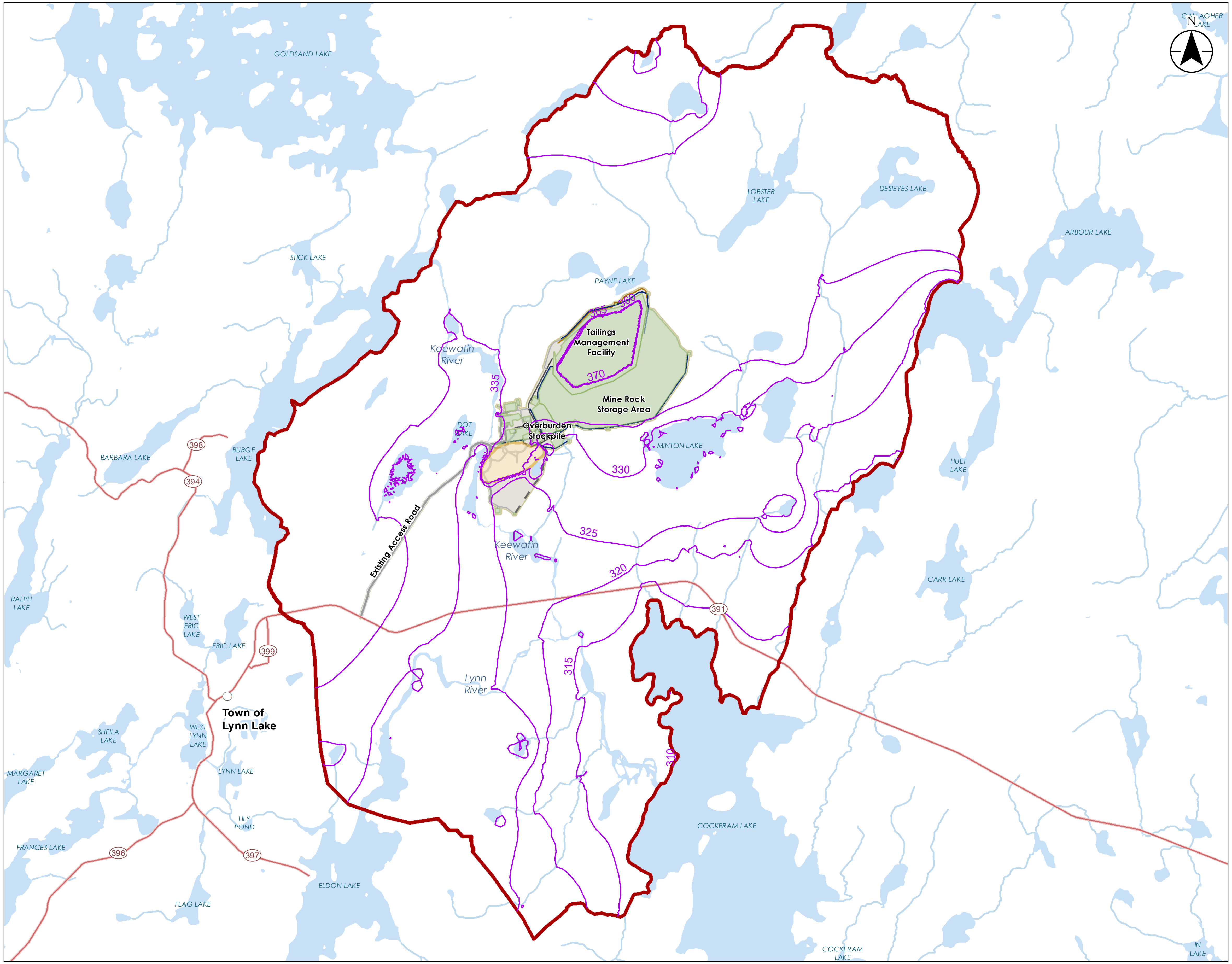
111473012
Prepared by AC on 2021-03-03
Technical Review by JK on 2021-03-03

Client/Project
LYNN LAKE GOLD PROJECT

Map No.
IAAC-90-1

Title
Water Table Elevation Contours at End of Operation - MacLellan (including contact water collection ditches)

G:_GIS_Project_Folder\111473008_LLGP_EA\IRs\Hydro-Geology\IAAC-76\Map_IAAC-90-1_WaterTableElevations_MacLellan_EndOfOperation_with_ditches_20210527.mxd Revised: 2021-05-27 By: ACampigotto



Stantec

Project Infrastructure

- ▨ Project Development Area
- ▨ Proposed Open Pit
- 🟩 Potential Infrastructure
- — Drainage Ditch
- — Existing Access Road
- — Access Road
- — Haul Road
- — Inplant Road
- — Toe Road
- – – Future Access Road

Study Area

- — Water Table Elevation Contours
- 🟥 Study Area

Landbase

- — Highway
- — Existing Access Road
- ▨ Waterbody

0 1 2 Kilometres

1:80,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base features provided by the Government of Manitoba and the Government of Canada.

Project Location
MacLellan Site
Lynn Lake, Manitoba

111473012
Prepared by AC on 2021-03-03
Technical Review by JK on 2021-03-03

Client/Project

LYNN LAKE GOLD PROJECT

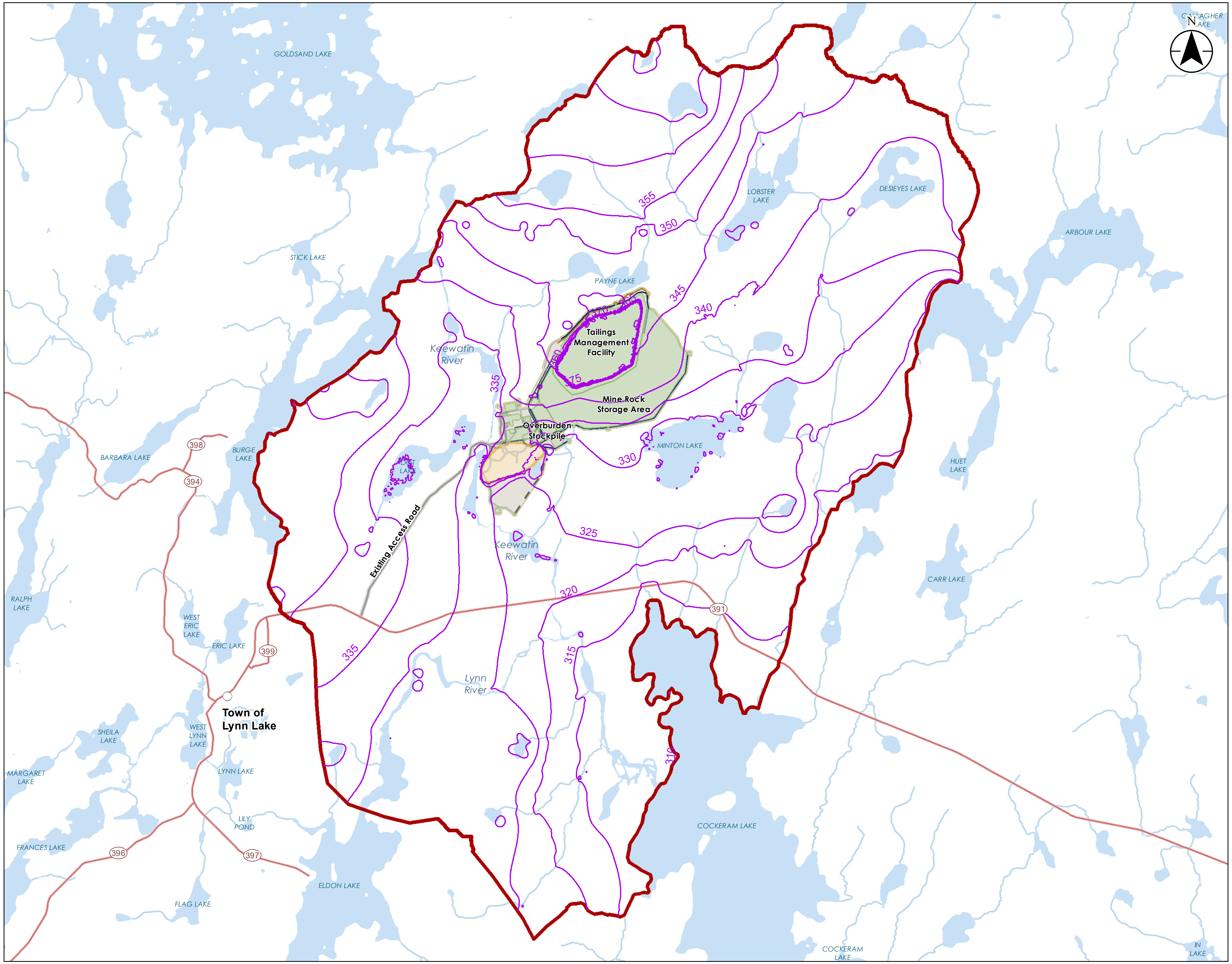
Map No.

IAAC-90-2

Title

Water Table Elevation Contours at End of Closure - MacLellan (no contact water collection ditches)

G:_GIS_Project_Folder\111473008_LLGP_EA\IRs\Hydro-Geology\IAAC-76\Map_IAAC-90-2_WaterTableElevationsEndClosureWithSeepage_MacLellan_20210527.mxd Revised: 2021-05-27 By: ACampigotto



Stantec

Project Infrastructure

- ▭ Project Development Area
- ▭ Propose Open Pit
- 🟩 Potential Infrastructure
- — Drainage Ditch
- — Existing Access Road
- — Access Road
- — Haul Road
- — Inplant Road
- — Toe Road
- – – Future Access Road

Study Area

- — Water Table Elevation Contours
- ▭ Study Area

Landbase

- — Highway
- — Existing Access Road
- ▭ Waterbody

0 1 2 Kilometres

1:80,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base features provided by the Government of Manitoba and the Government of Canada.

Project Location
MacLellan Site
Lynn Lake, Manitoba

111473012

Prepared by AC on 2021-03-03
Technical Review by JK on 2021-03-03

Client/Project

LYNN LAKE GOLD PROJECT

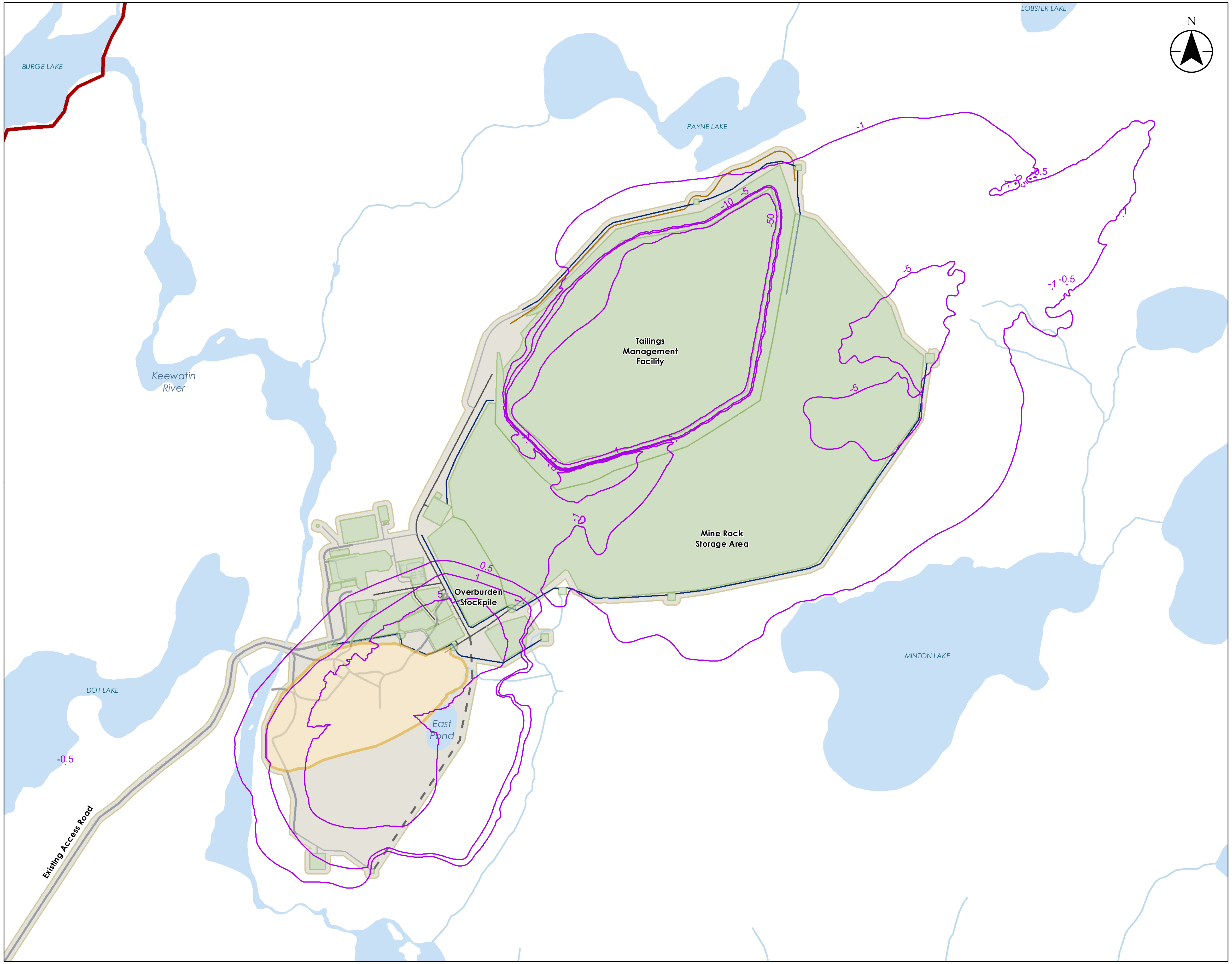
Map No.

IAAC-90-3

Title

Water Table Elevation Contours at End of Closure - MacLellan (including contact water collection ditches)

G:_GIS_Project_Folder\111473008_LLGP_EA\IRs\Hydro-Geology\IAAC-76\Map_IAAC-90-3_WaterTableElevations_MacLellan_EndOfClosure_with_ditches_20210527.mxd Revised: 2021-05-27 By: ACampigotto



Stantec

Project Infrastructure

- ▨ Project Development Area
- 🟧 Proposed Open Pit
- 🟩 Potential Infrastructure
- — Drainage Ditch
- — Existing Access Road
- — Access Road
- — Haul Road
- — Inplant Road
- — Toe Road
- - - Future Access Road

Study Area

- — Water Table Drawdown Contours
- 🟥 Study Area

Landbase

- — Existing Access Road
- ▨ Waterbody

0 0.5 1 Kilometres

1:25,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base features provided by the Government of Manitoba and the Government of Canada.

Project Location
MacLellan Site
Lynn Lake, Manitoba

111473012
Prepared by AC on 2021-03-03
Technical Review by JK on 2021-03-03

Client/Project

LYNN LAKE GOLD PROJECT

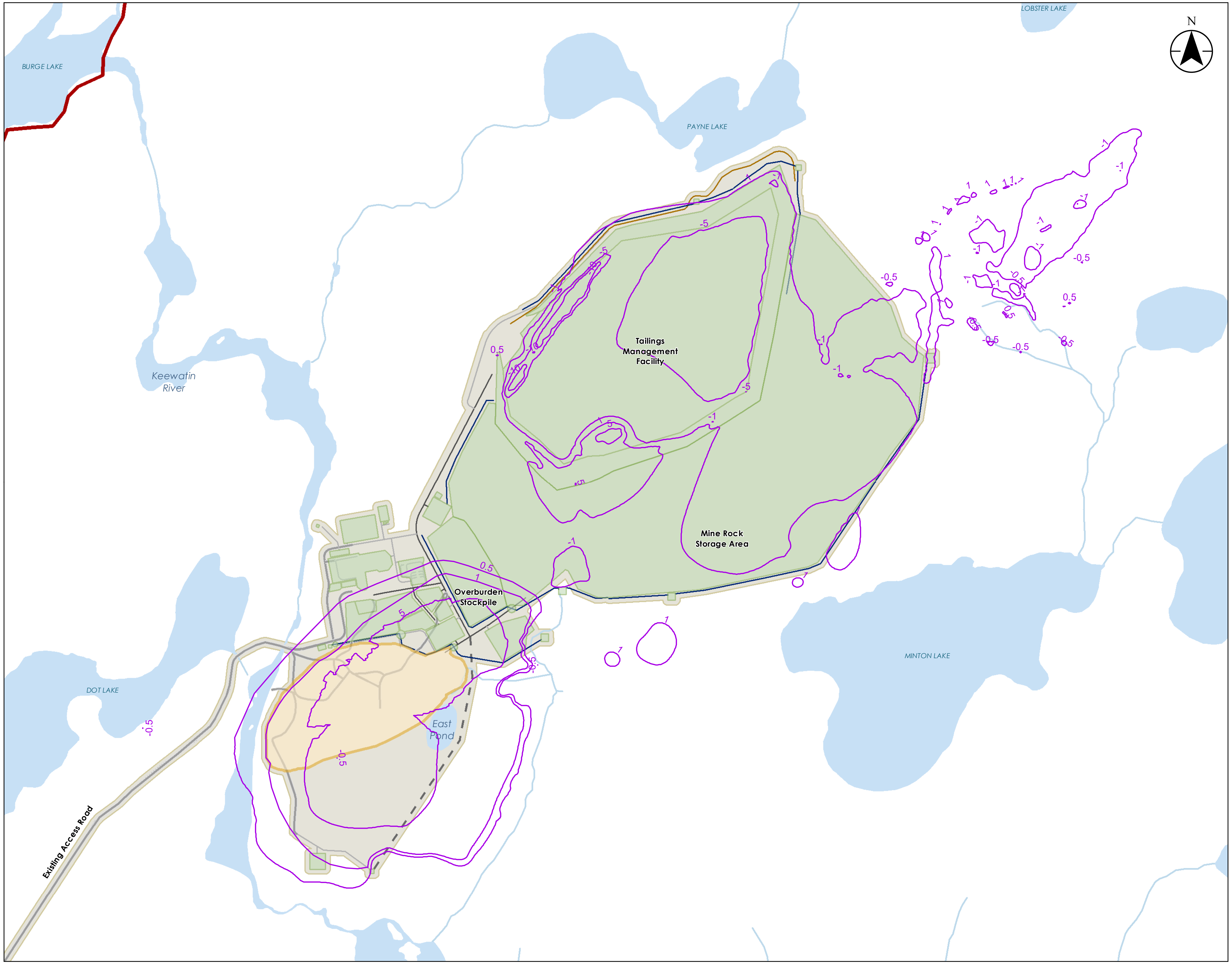
Map No.

IAAC-90-4

Title

Simulated Water Table Drawdown at End of Closure - MacLellan (no contact water collection ditches)

G:_GIS_Project_Folder\111473008_LLGP_EA\IRs\Hydro-Geology\IAAC-76\Map_IAAC-90-4_SimulatedWaterTableDrawdownEOCWithSeepage_MacLellan_20210527.mxd Revised: 2021-05-27 By: ACampigotto



Stantec

Project Infrastructure

- ▭ Project Development Area
- ▭ Proposed Open Pit
- 🟩 Potential Infrastructure
- — Drainage Ditch
- — Existing Access Road
- — Access Road
- — Haul Road
- — Inplant Road
- — Toe Road
- - - Future Access Road

Study Area

- — Water Table Drawdown Contours
- 🟥 Study Area

Landbase

- — Existing Access Road
- ▭ Waterbody

0 0.5 1 Kilometres

1:25,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base features provided by the Government of Manitoba and the Government of Canada.

Project Location
MacLellan Site
Lynn Lake, Manitoba

111473012
Prepared by AC on 2021-03-03
Technical Review by JK on 2021-03-03

Client/Project

LYNN LAKE GOLD PROJECT

Map No.

IAAC-90-5

Title

Simulated Water Table Drawdown at End of Closure - MacLellan (including contact water collection ditches)

G:_GIS_Project_Folder\111473008_LLGP_EA\IRs\Hydro-Geology\IAAC-76\Map_IAAC-90-5_SimulatedWaterTableDrawdownEOCWithSeepage_with_ditches_MacLellan_20210527.mxd Revised: 2021-05-27 By: ACampigotto

A.13 ATTACHMENT IAAC-92

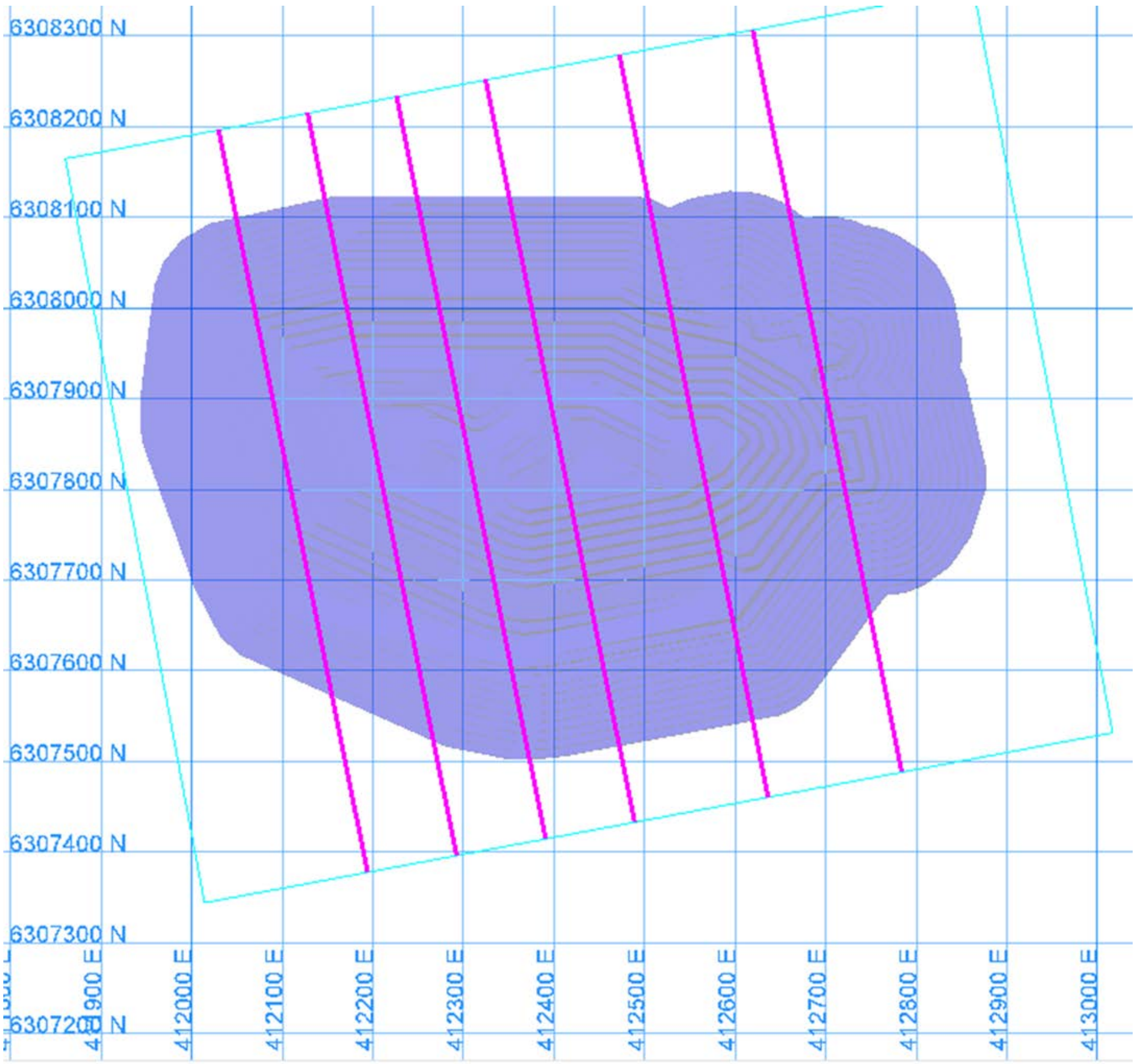


Figure IAAC-92-1a Gordon Block Model: FSU Reserve Pit and Cross-Section Locations

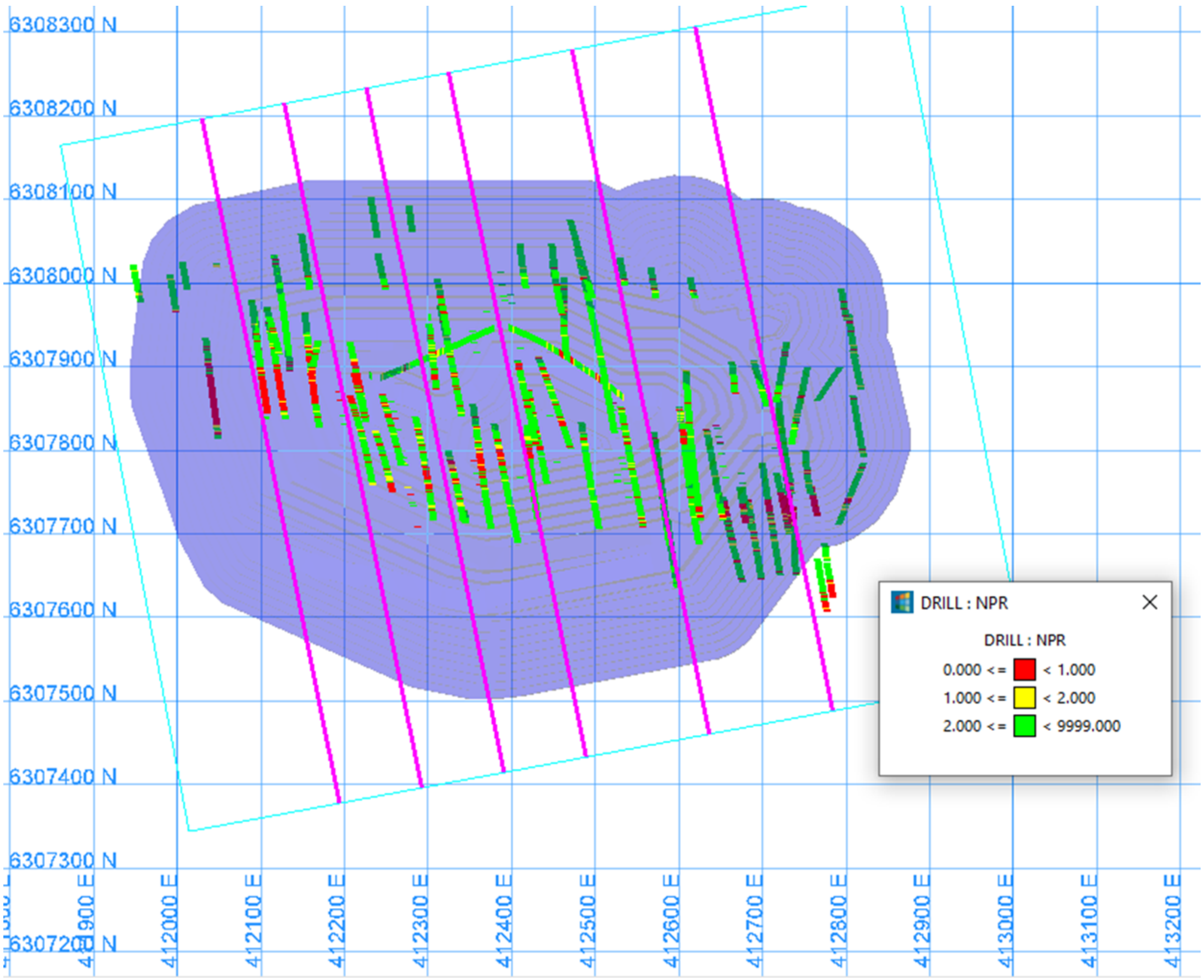
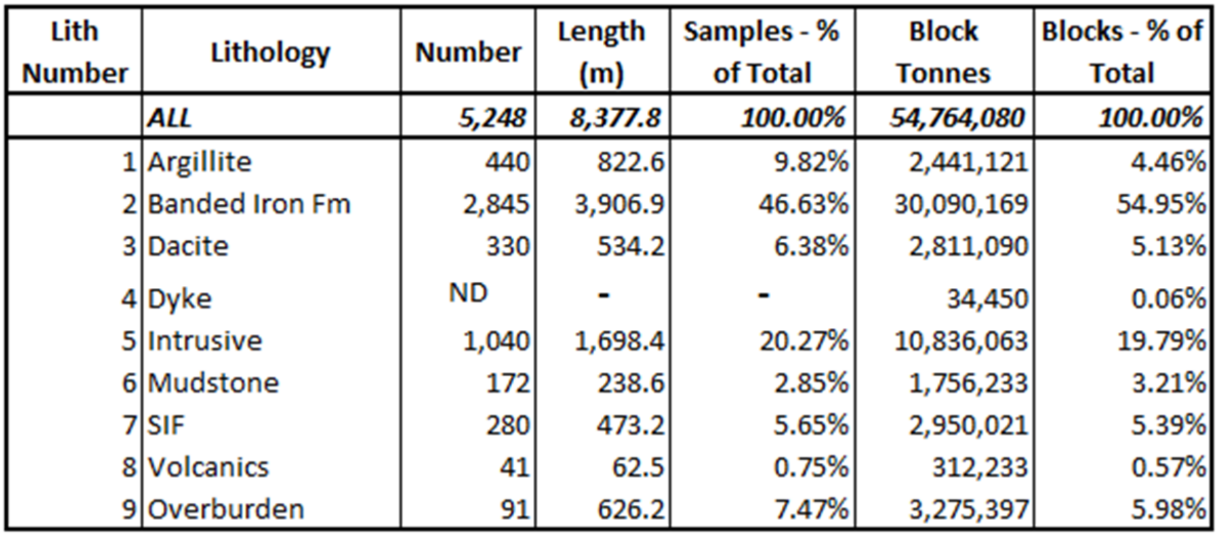


Figure IAAC-92-1b Gordon Block Model: FSU Reserve Pit and NPR Sample Locations



Lith Number	Lithology	Number	Length (m)	Samples - % of Total	Block Tonnes	Blocks - % of Total
	ALL	***5,248***	***8,377.8***	***100.00%***	***54,764,080***	***100.00%***
1	Argillite	440	822.6	9.82%	2,441,121	4.46%
2	Banded Iron Fm	2,845	3,906.9	46.63%	30,090,169	54.95%
3	Dacite	330	534.2	6.38%	2,811,090	5.13%
4	Dyke	ND	-	-	34,450	0.06%
5	Intrusive	1,040	1,698.4	20.27%	10,836,063	19.79%
6	Mudstone	172	238.6	2.85%	1,756,233	3.21%
7	SIF	280	473.2	5.65%	2,950,021	5.39%
8	Volcanics	41	62.5	0.75%	312,233	0.57%
9	Overburden	91	626.2	7.47%	3,275,397	5.98%

Figure IAAC-92-1c Gordon: Raw Data and Block Model Statistics – FSU Pit (ND = No Data)

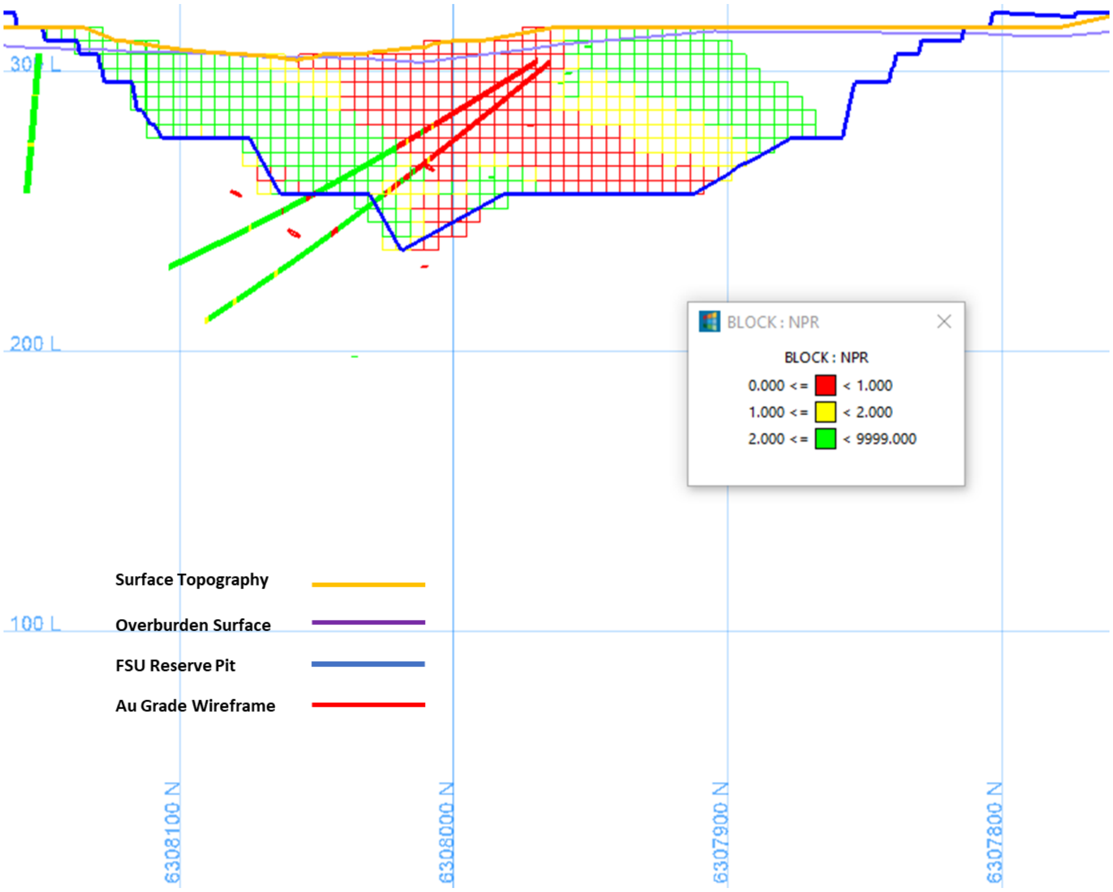


Figure IAAC-92-1d Gordon Block Model: NPR Values and Drillhole NPR Values – Section 1

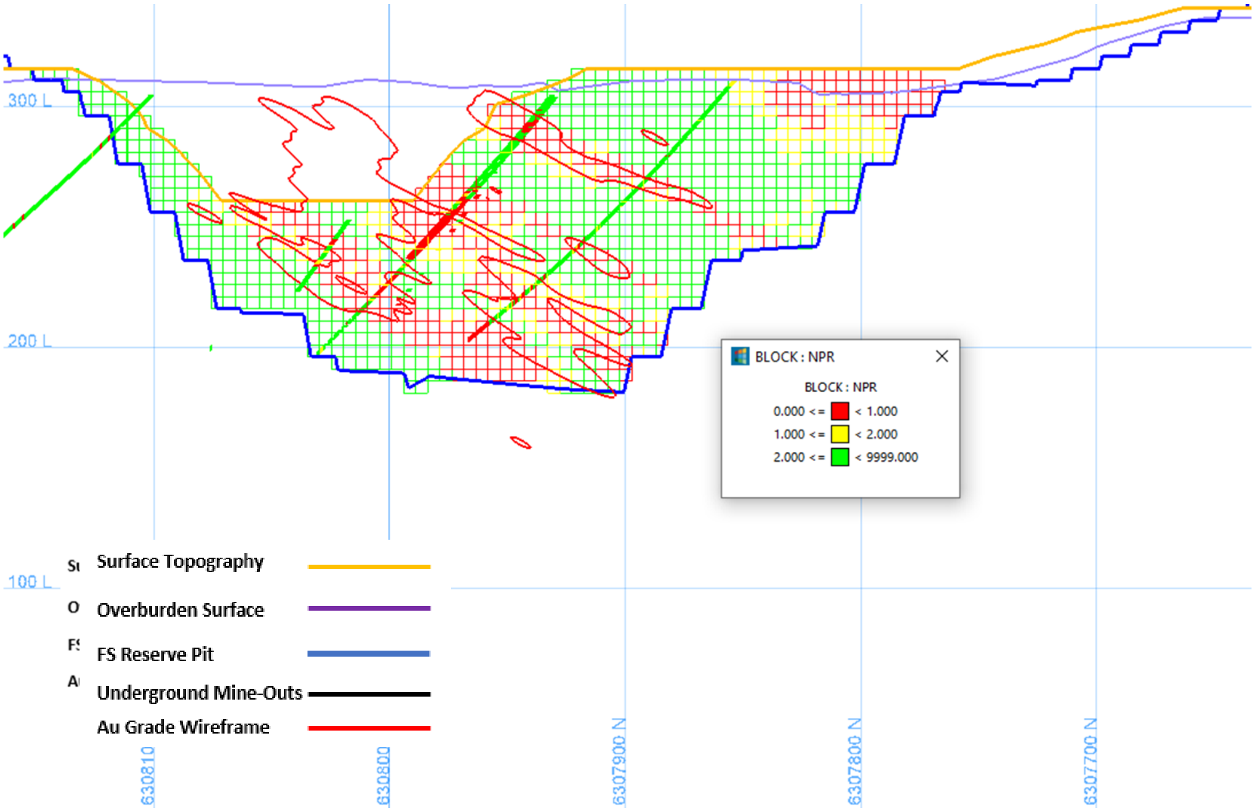


Figure IAAC-92-1e Gordon Block Model: NPR Values and Drillhole NPR Values – Section 2

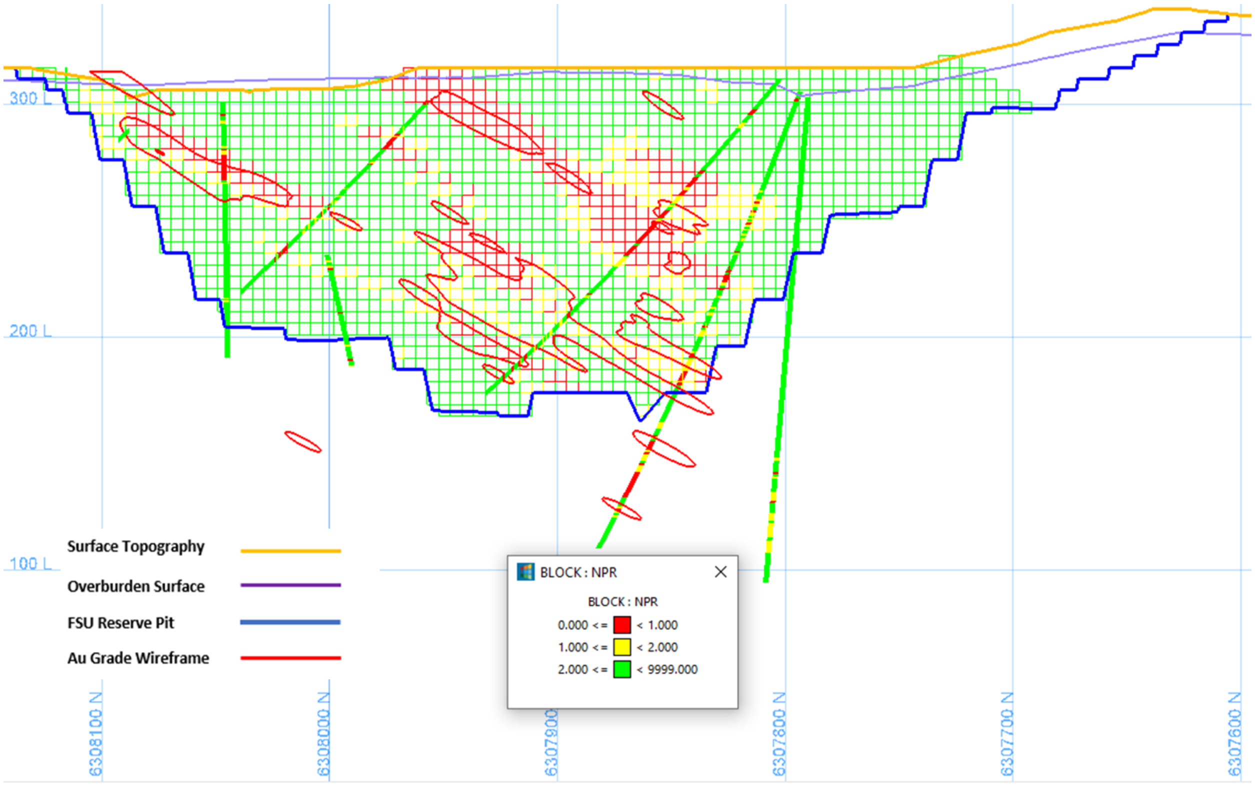


Figure IAAC-92-1f Gordon Block Model: NPR Values and Drillhole NPR Values – Section 3

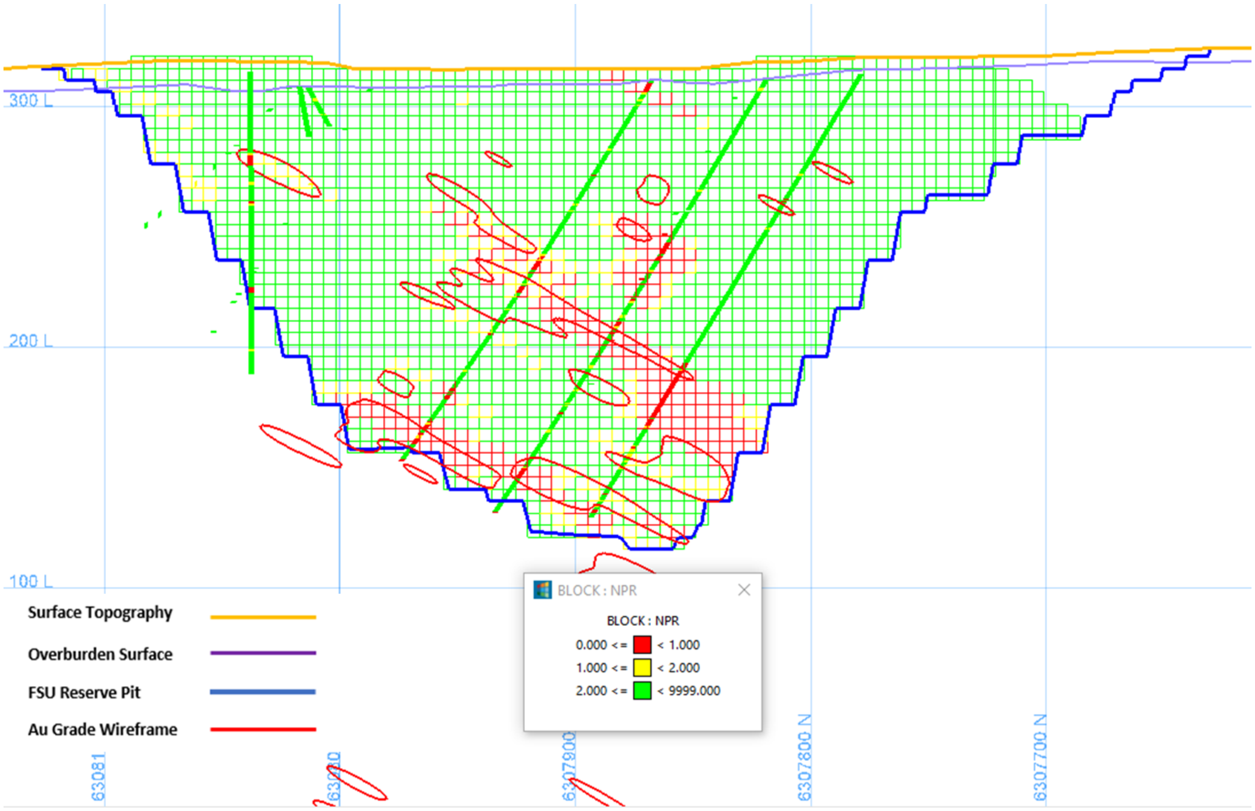


Figure IAAC-92-1g Gordon Block Model: NPR Values and Drillhole NPR Values – Section 4

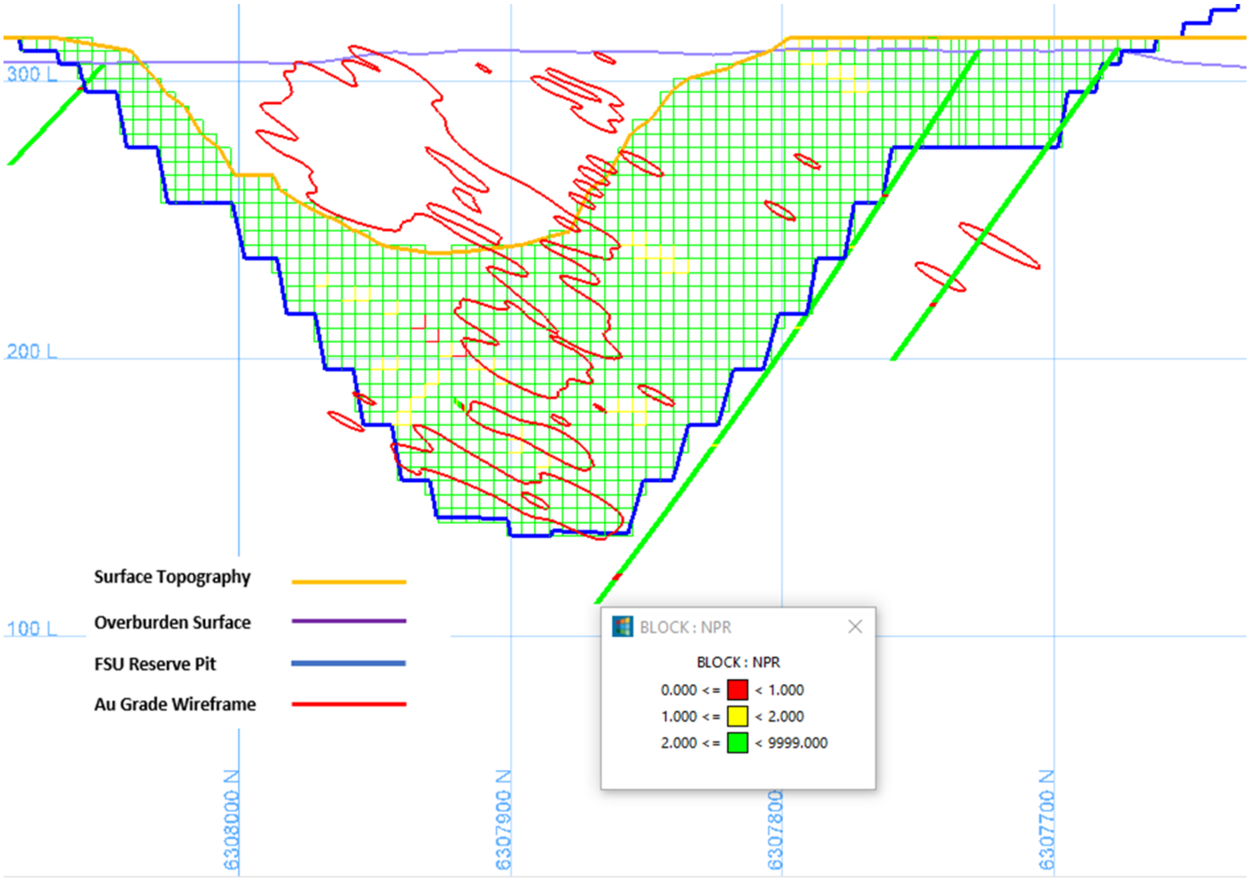


Figure IAAC-92-1h Gordon Block Model: NPR Values and Drillhole NPR Values – Section 5

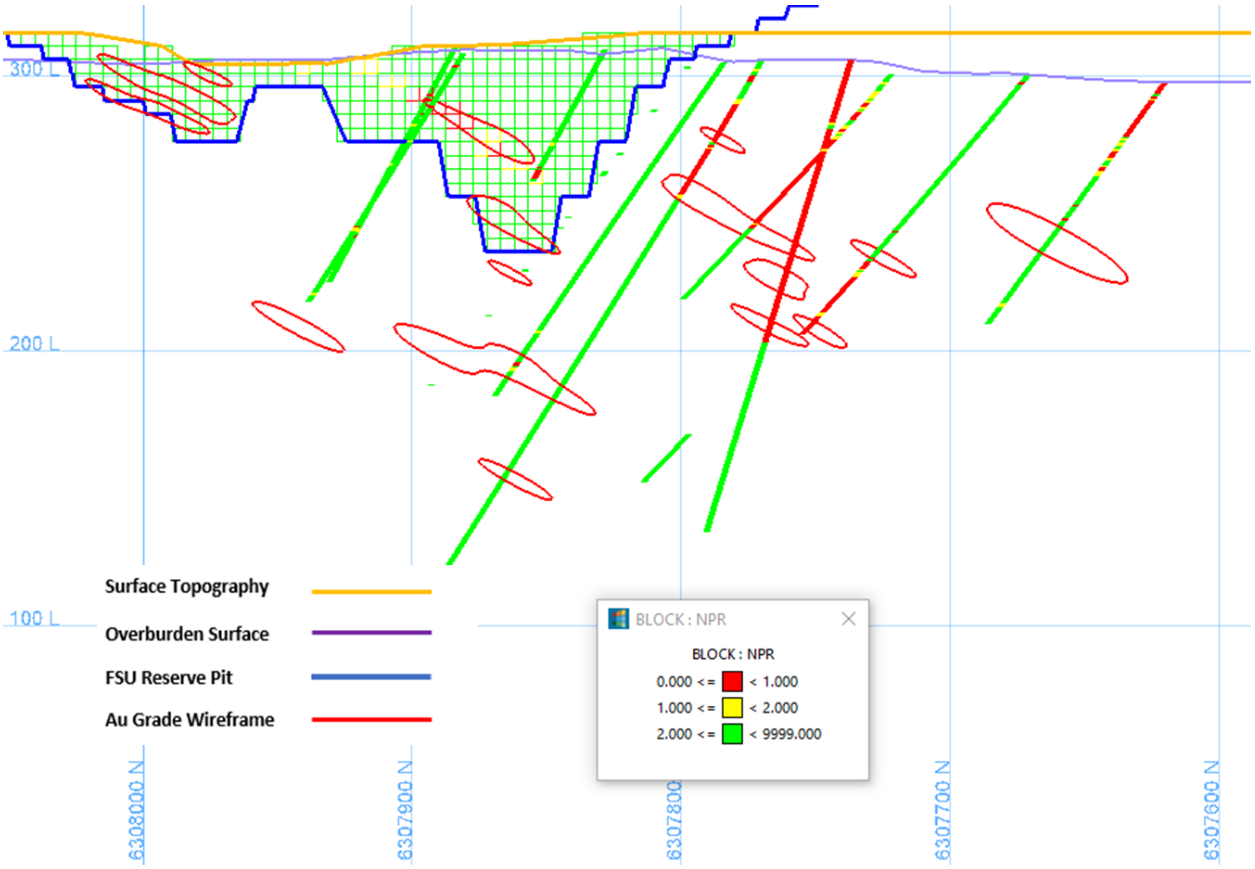


Figure IAAC-92-1i Gordon Block Model: NPR Values and Drillhole NPR Values – Section 6

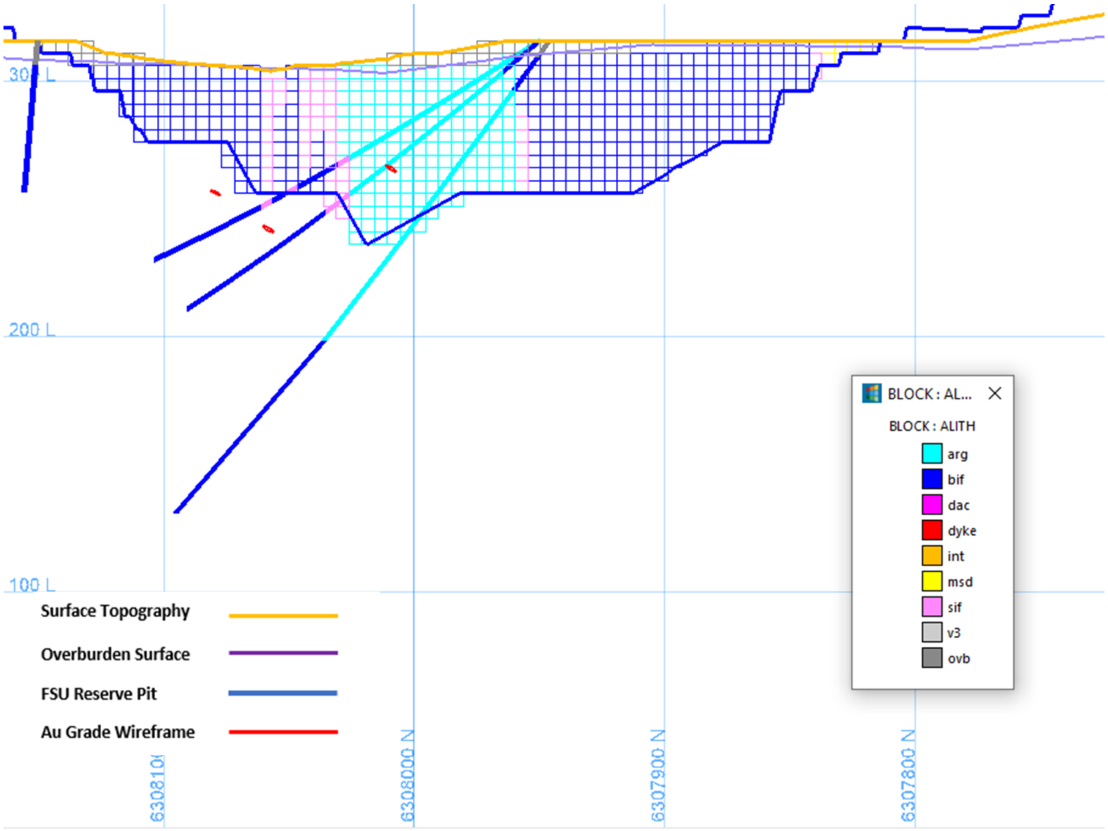


Figure IAAC-92-1j Gordon Block Model: Block Model Lithology and Drillhole Lithology – Section 1

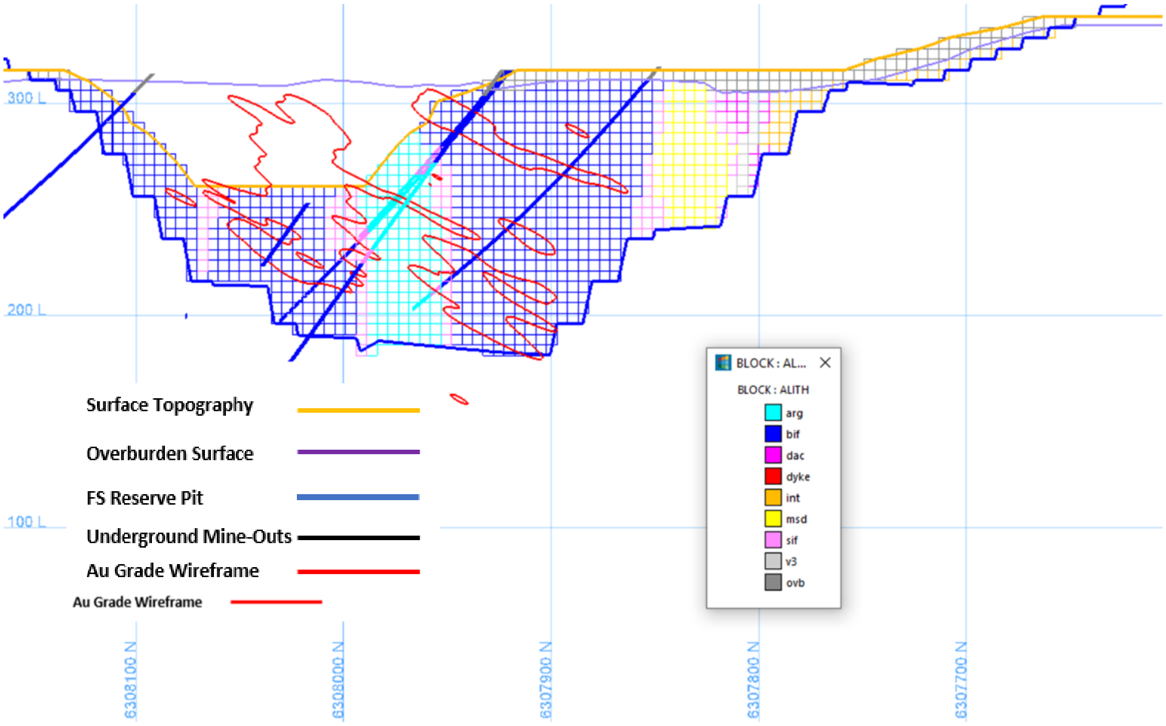


Figure IAAC-92-1k Gordon Block Model: Block Model Lithology and Drillhole Lithology – Section 2

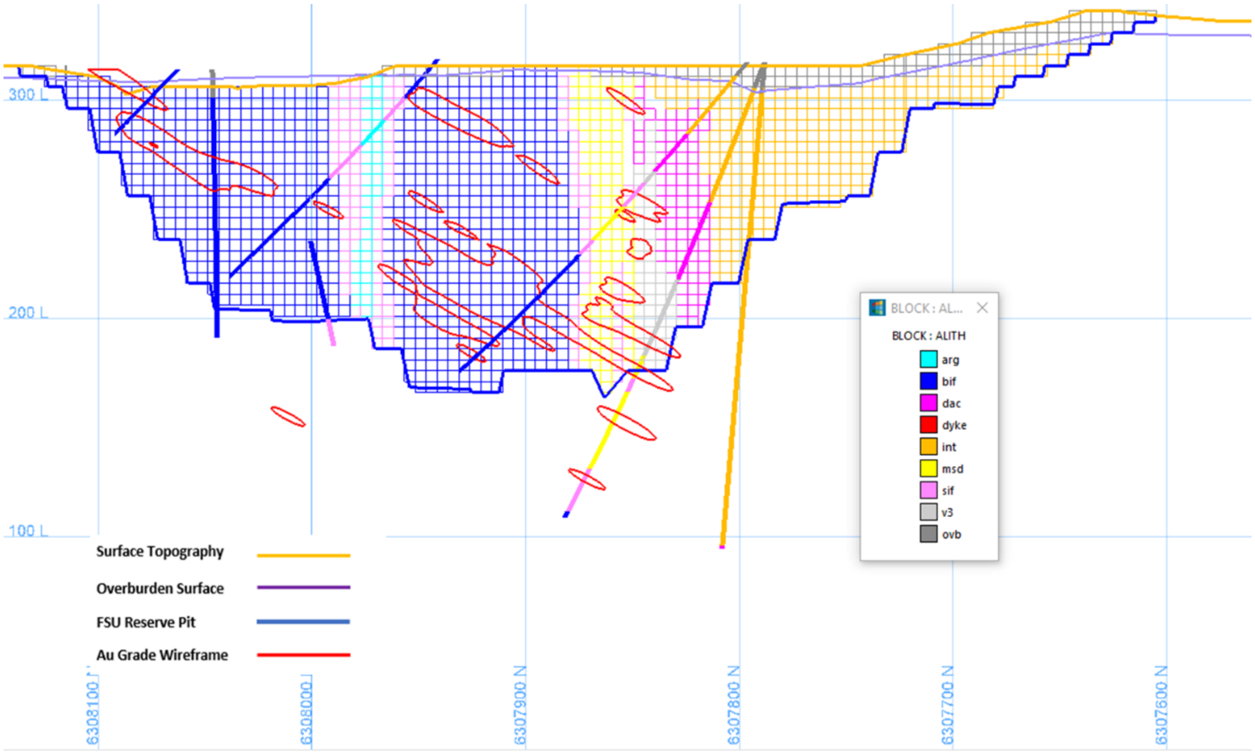


Figure IAAC-92-1I Gordon Block Model: Block Model Lithology and Drillhole Lithology – Section 3

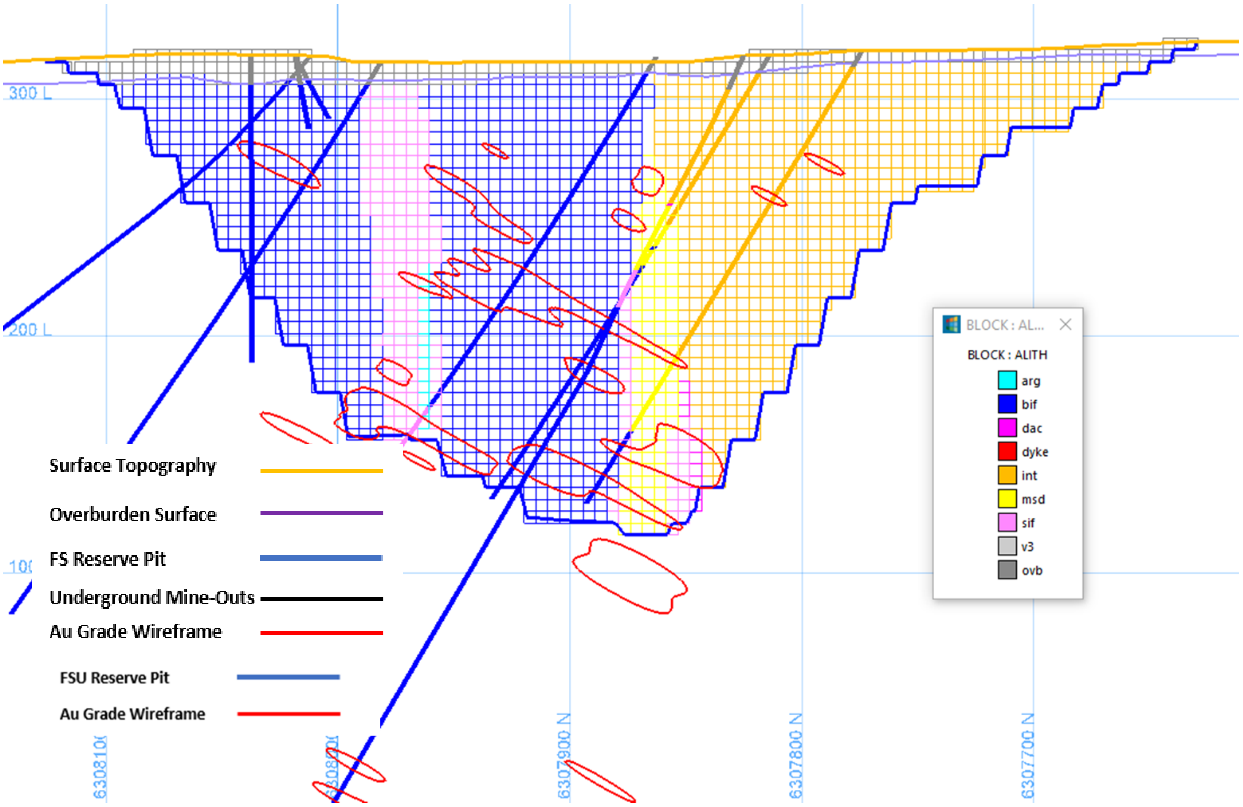


Figure IAAC-92-1m Gordon Block Model: Block Model Lithology and Drillhole Lithology – Section 4

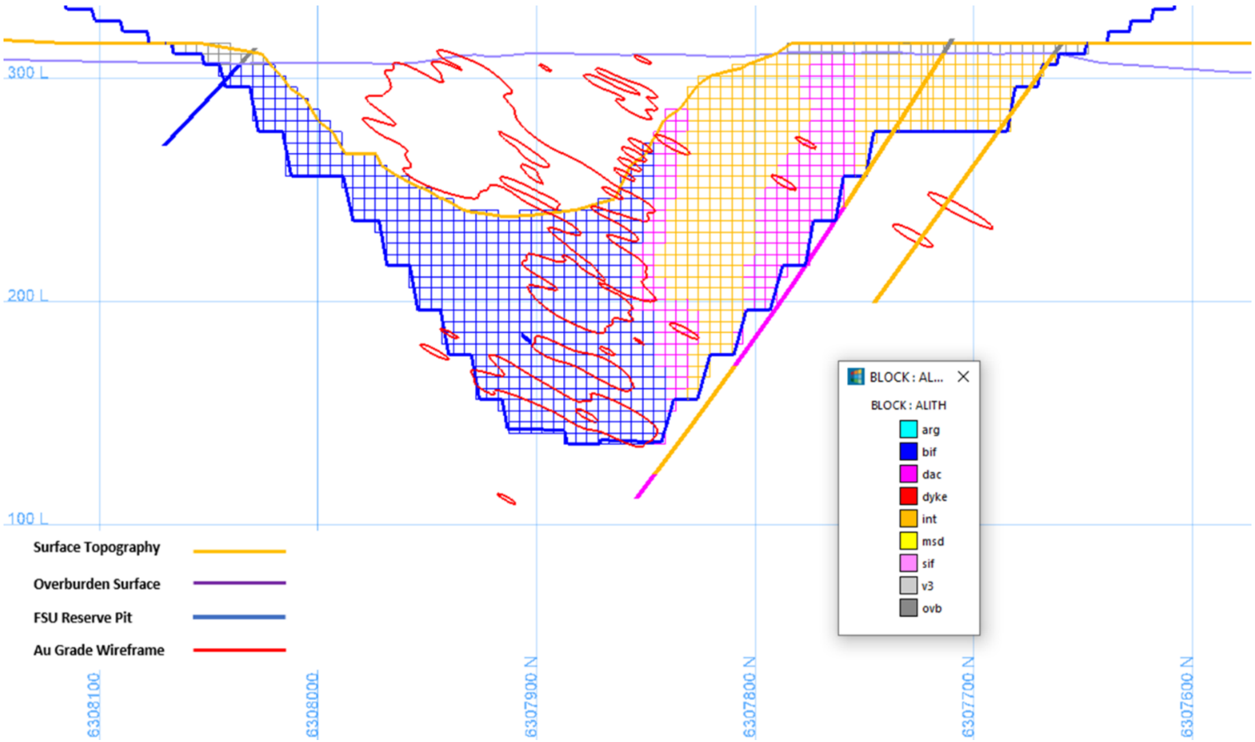


Figure IAAC-92-1n Gordon Block Model: Block Model Lithology and Drillhole Lithology – Section 5

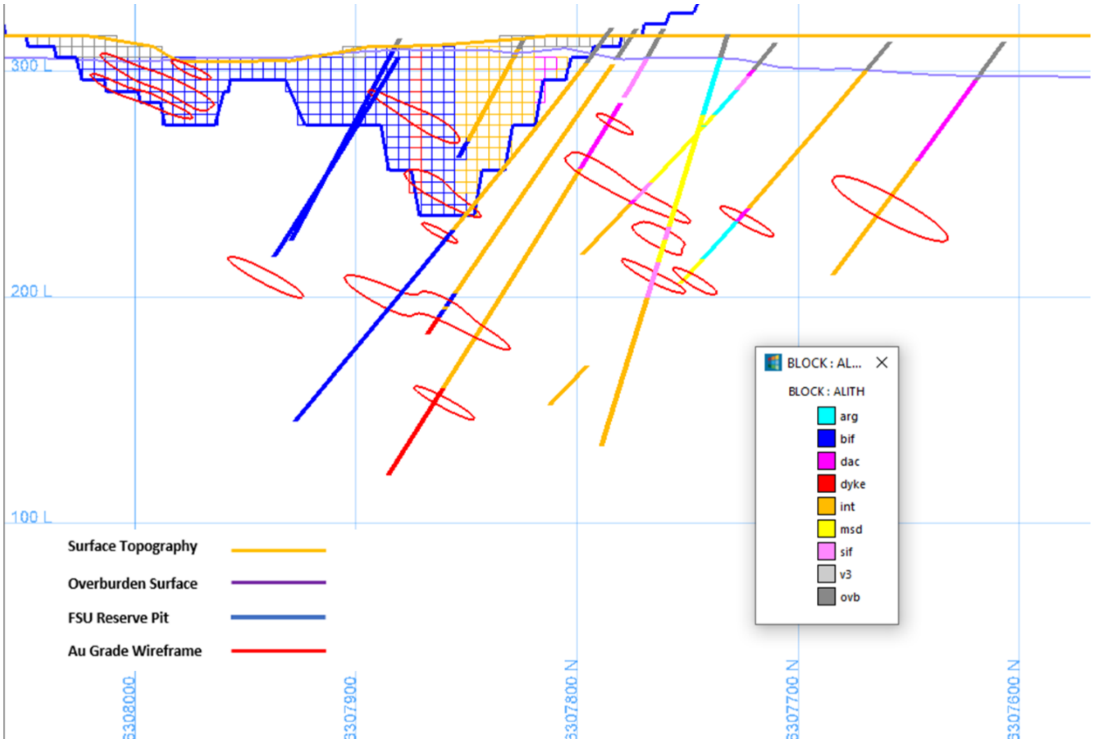


Figure IAAC-92-1m Gordon Block Model: Block Model Lithology and Drillhole Lithology – Section 6

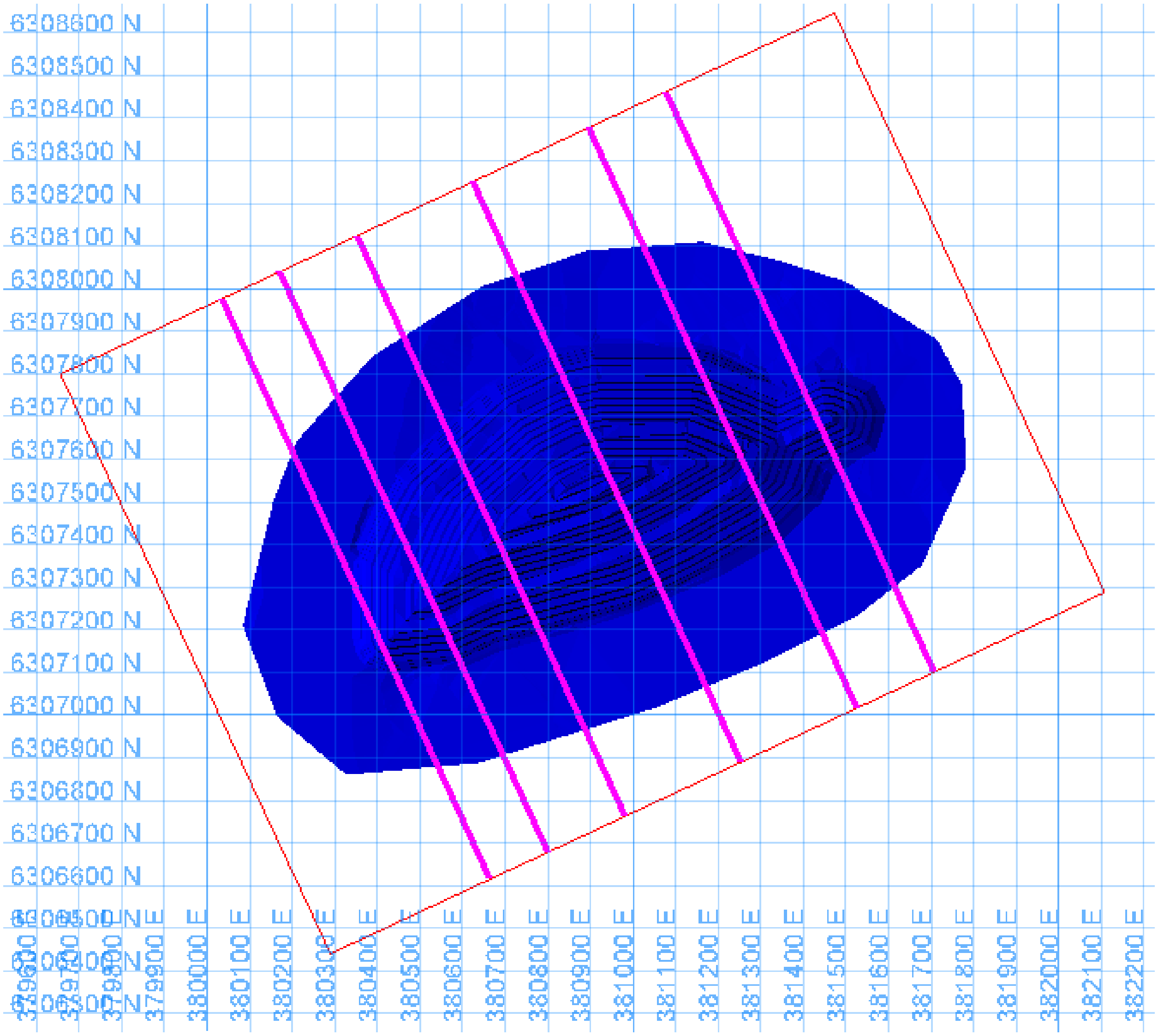


Figure IAAC-92-2a MacLellan Block Model: Cross-Section Locations

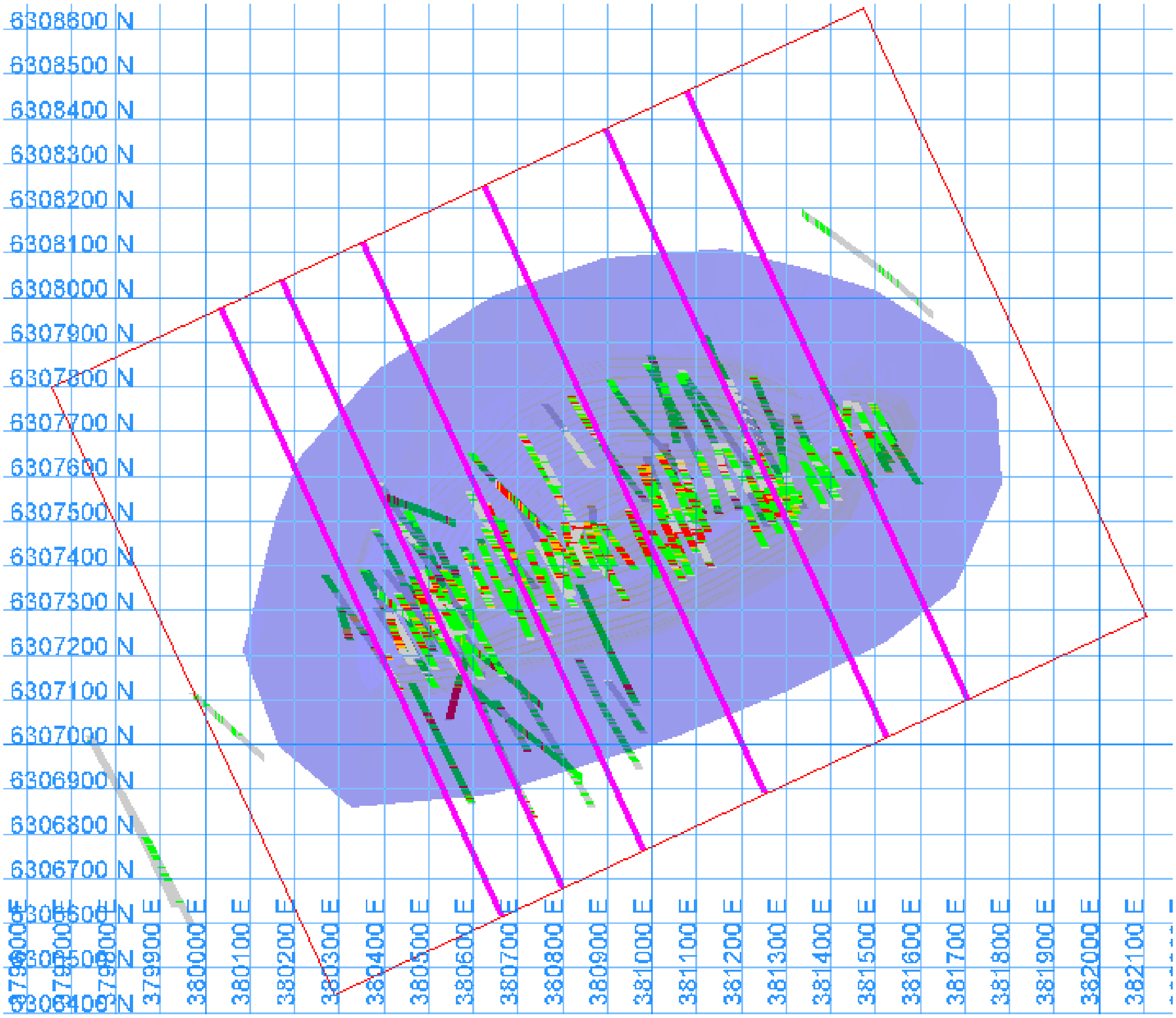
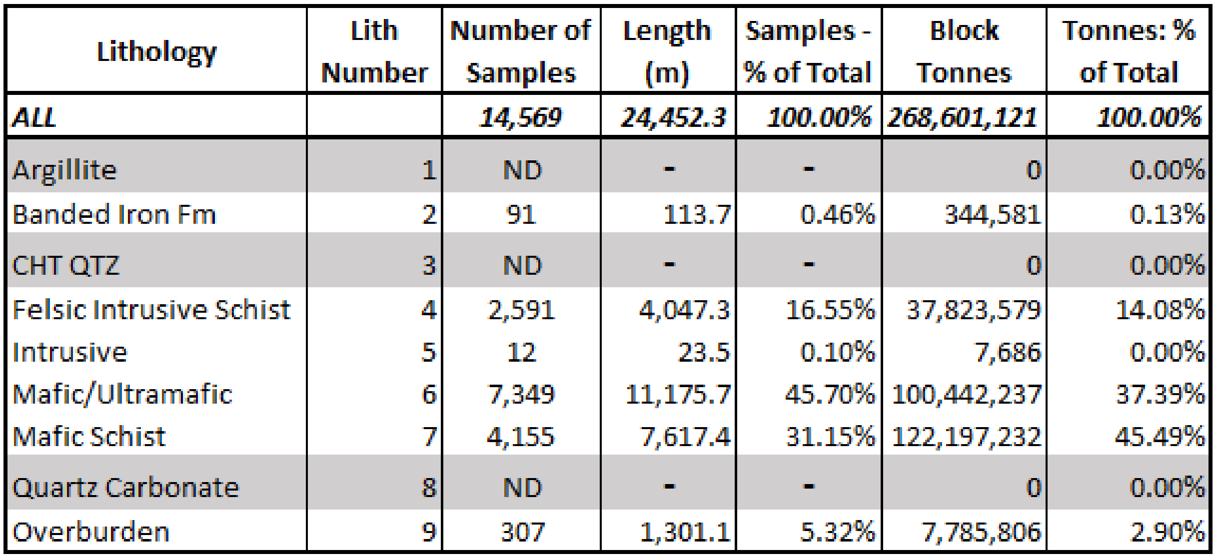


Figure IAAC-92-2b MacLellan Block Model: ARD Sample Locations



Lithology	Lith Number	Number of Samples	Length (m)	Samples - % of Total	Block Tonnes	Tonnes: % of Total
ALL		***14,569***	***24,452.3***	***100.00%***	***268,601,121***	***100.00%***
Argillite	1	ND	-	-	0	0.00%
Banded Iron Fm	2	91	113.7	0.46%	344,581	0.13%
CHT QTZ	3	ND	-	-	0	0.00%
Felsic Intrusive Schist	4	2,591	4,047.3	16.55%	37,823,579	14.08%
Intrusive	5	12	23.5	0.10%	7,686	0.00%
Mafic/Ultramafic	6	7,349	11,175.7	45.70%	100,442,237	37.39%
Mafic Schist	7	4,155	7,617.4	31.15%	122,197,232	45.49%
Quartz Carbonate	8	ND	-	-	0	0.00%
Overburden	9	307	1,301.1	5.32%	7,785,806	2.90%

Figure IAAC-92-2c MacLellan: Raw Data and Block Model Statistics by Lithology – FSU Pit

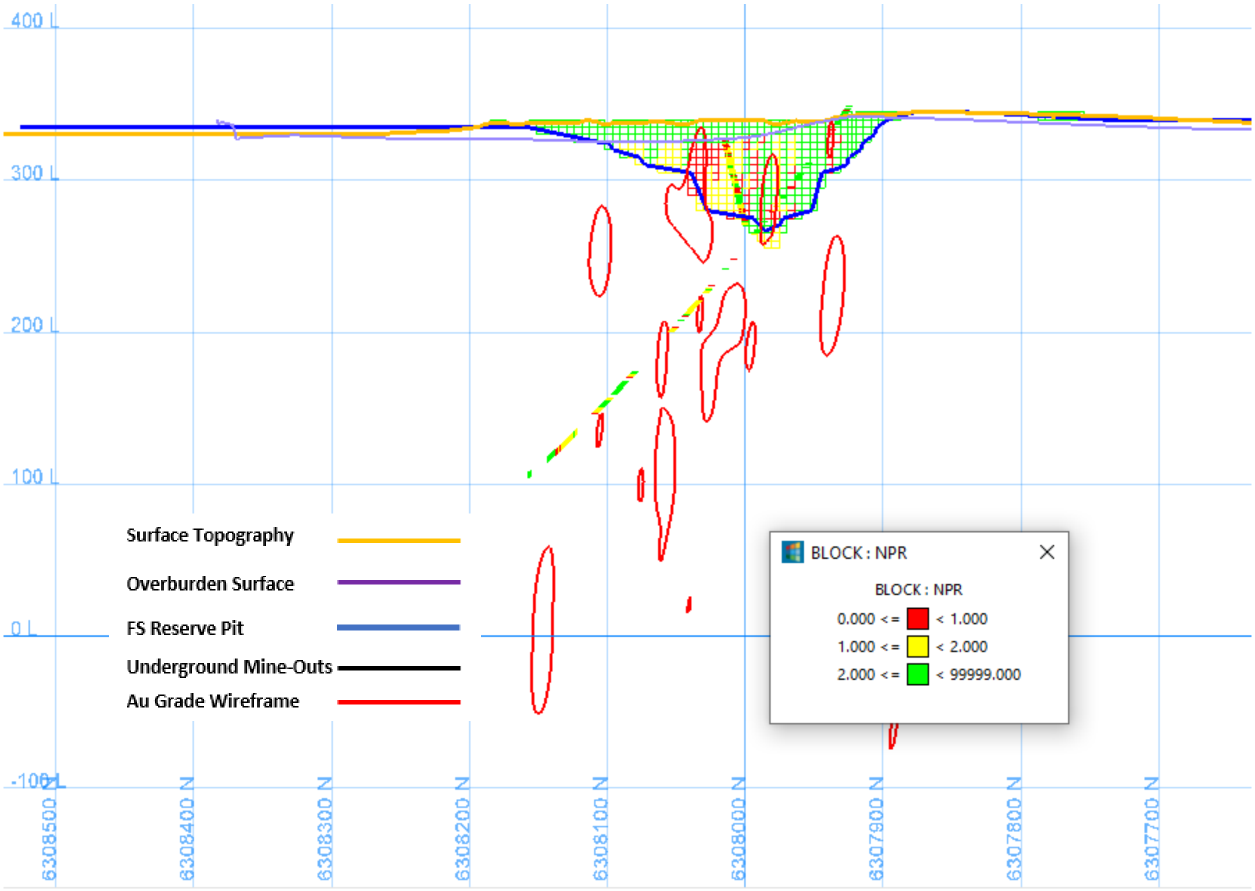


Figure IAAC-92-2d MacLellan Block Model: NPR Values and Drillhole NPR Values – Section 1

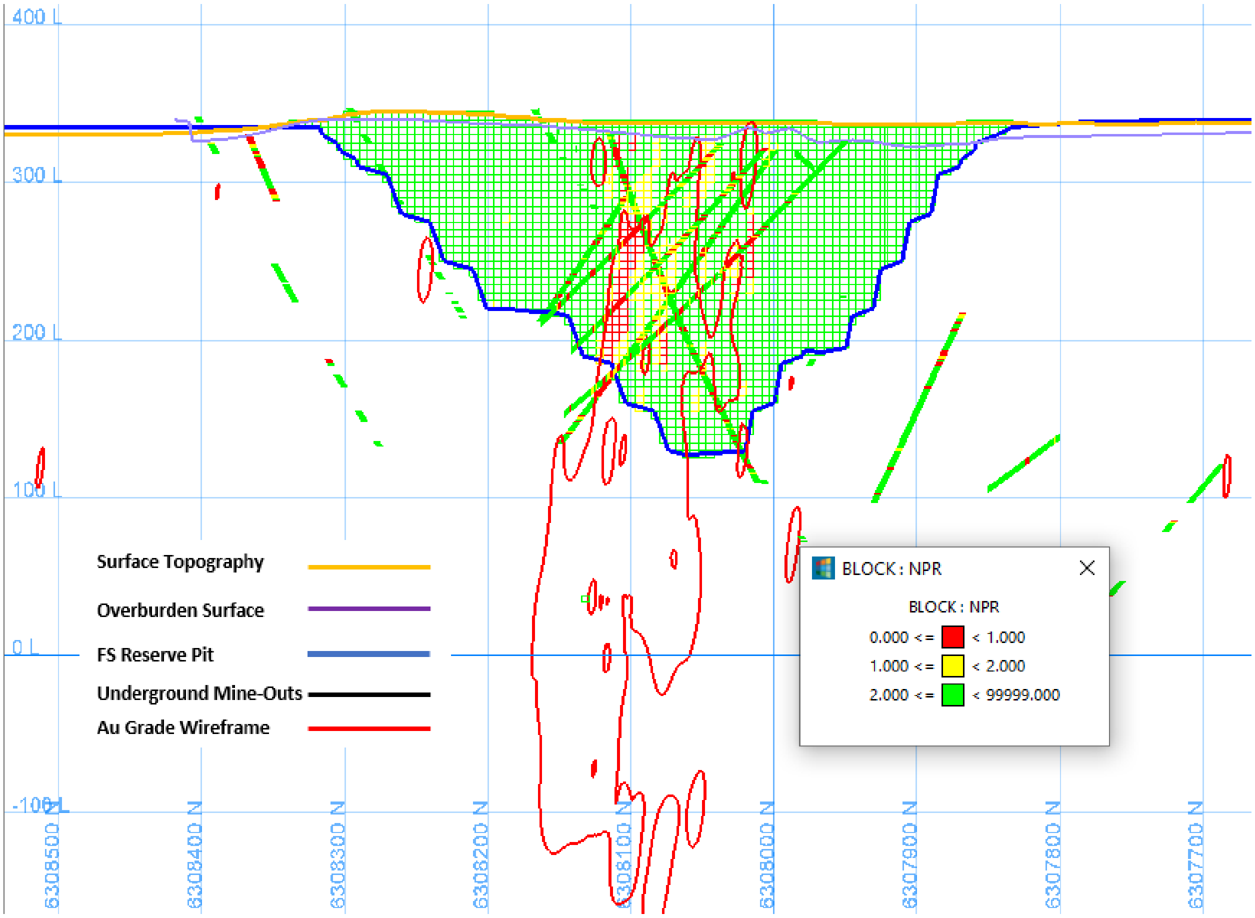


Figure IAAC-92-2e MacLellan Block Model: NPR Values and Drillhole NPR Values – Section 2

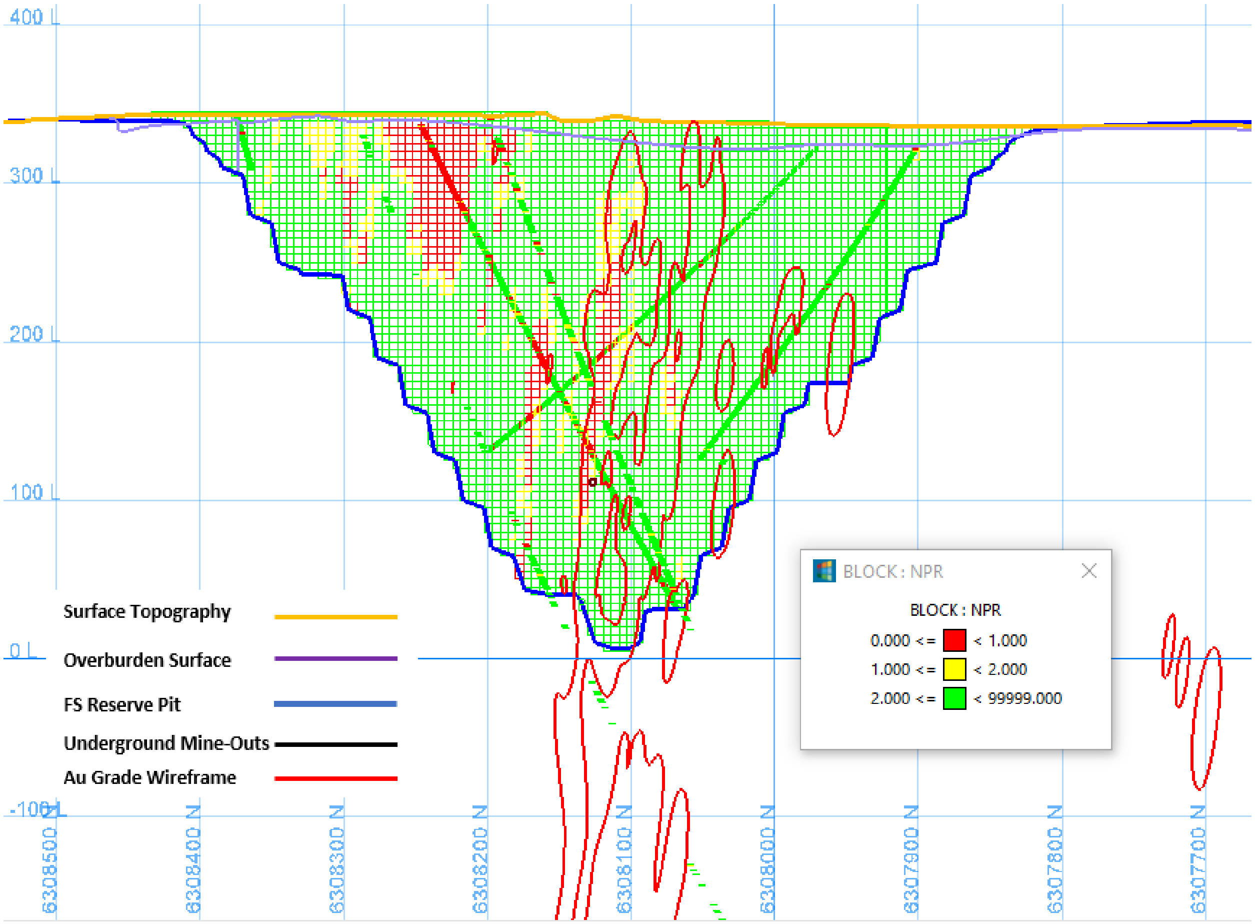


Figure IAAC-92-2f MacLellan Block Model: NPR Values and Drillhole NPR Values – Section 3

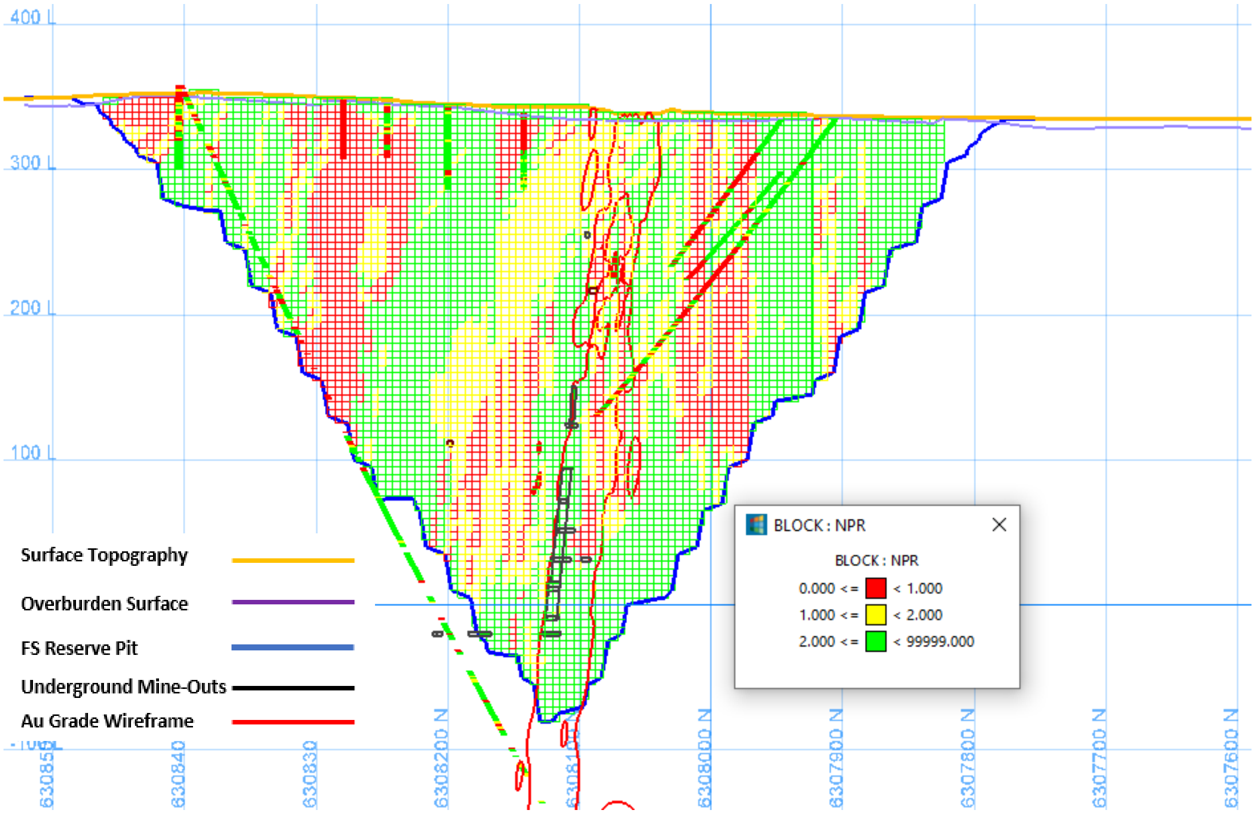


Figure IAAC-92-2g MacLellan Block Model: NPR Values and Drillhole NPR Values – Section 4

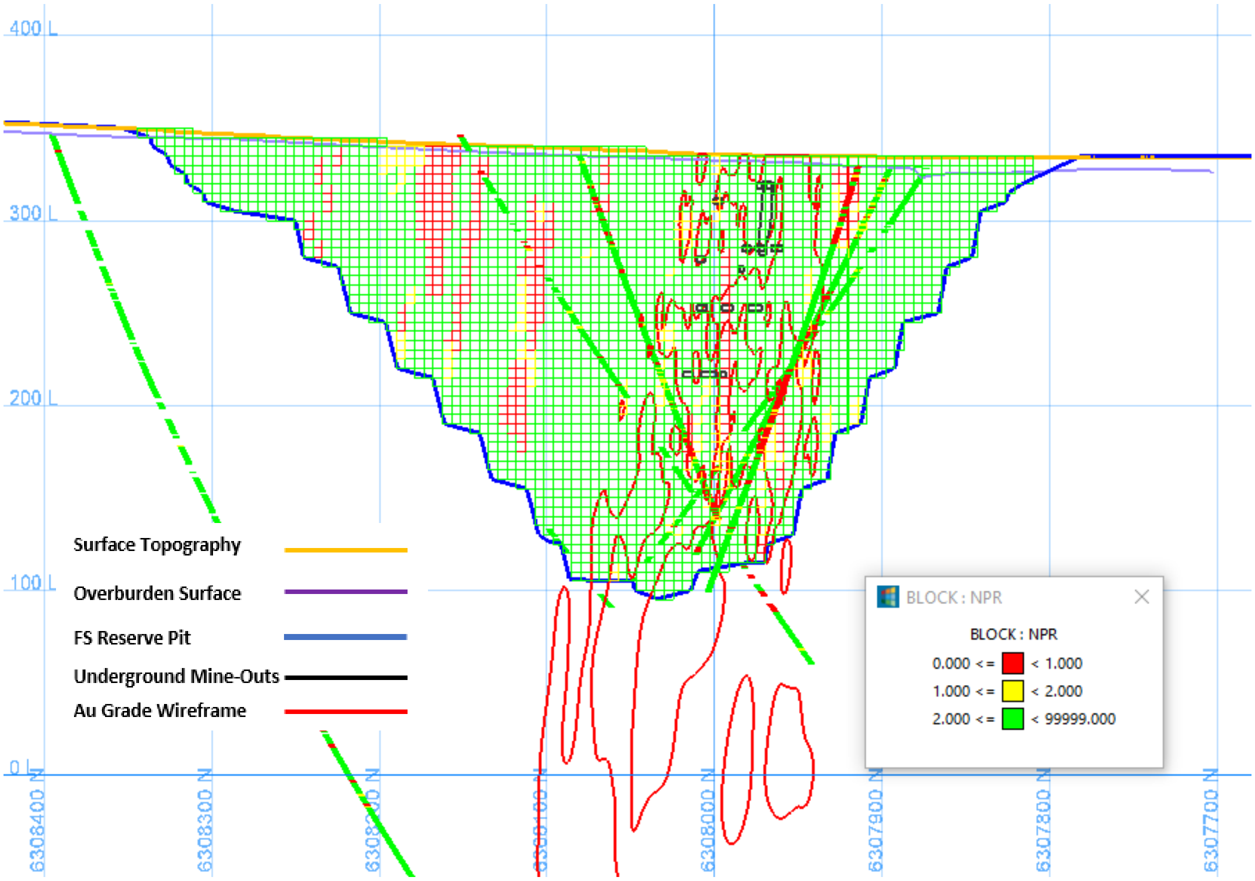


Figure IAAC-92-2h MacLellan Block Model: NPR Values and Drillhole NPR Values – Section 5

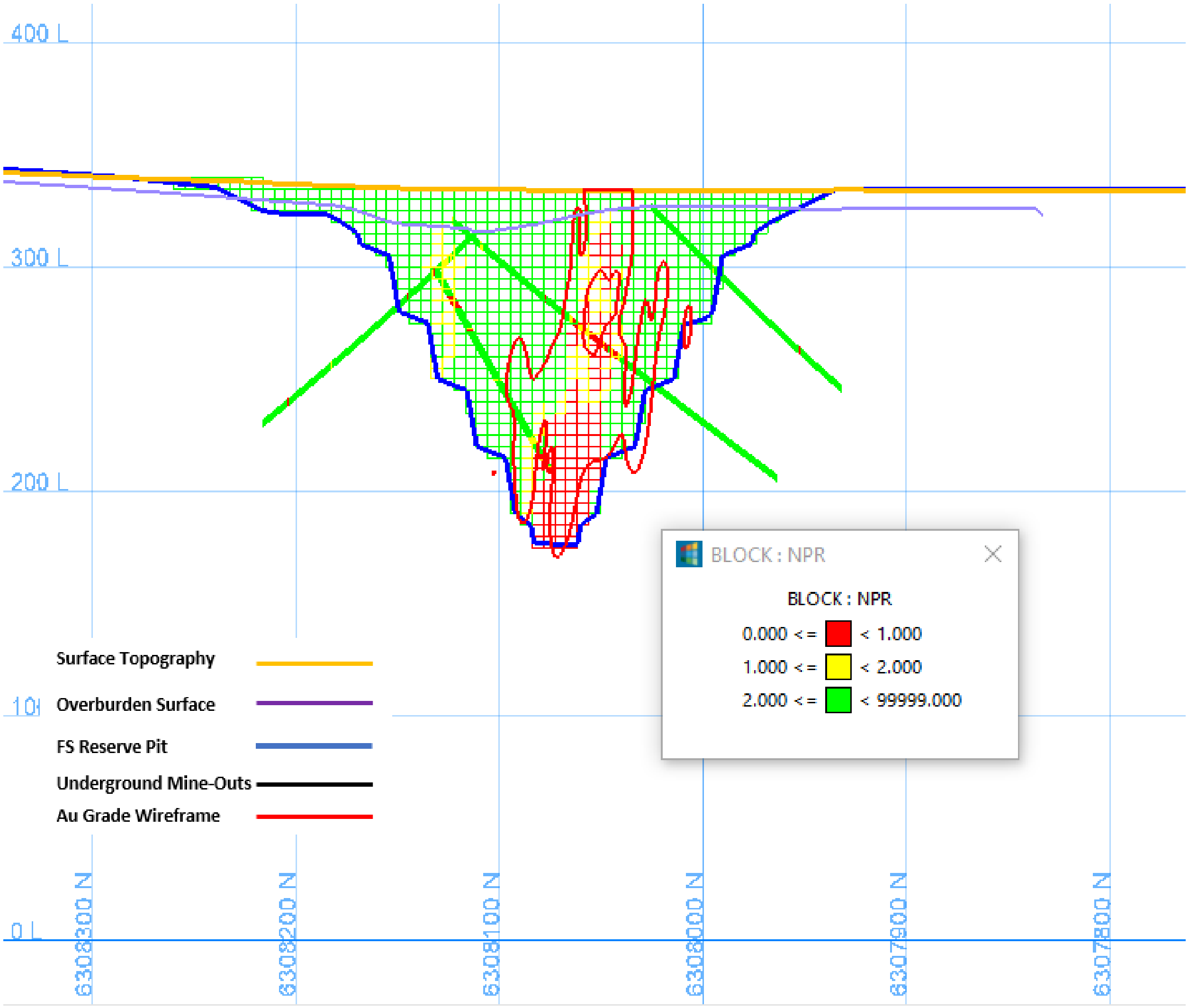


Figure IAAC-92-2i MacLellan Block Model: NPR Values and Drillhole NPR Values – Section 6

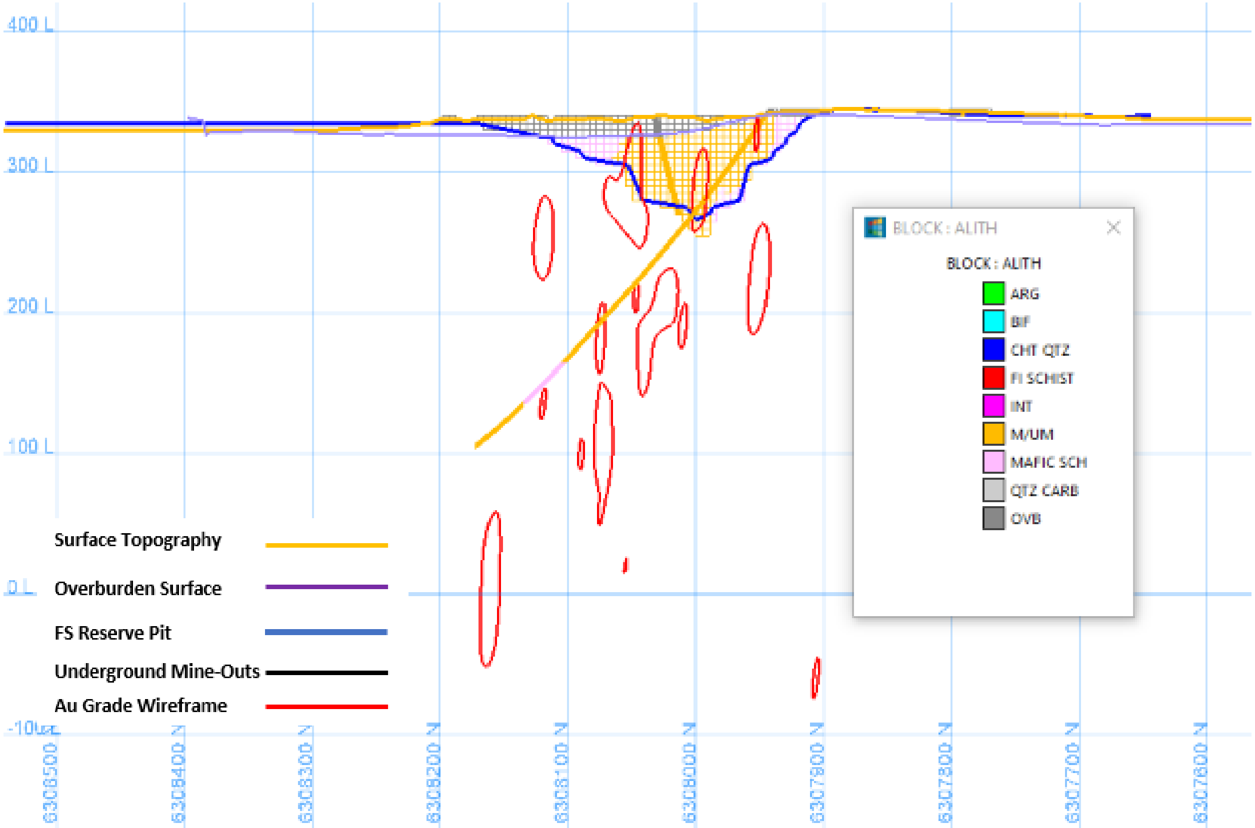


Figure IAAC-92-2j MacLellan Block Model: Block Model Lithology and Drillhole Lithology – Section 1

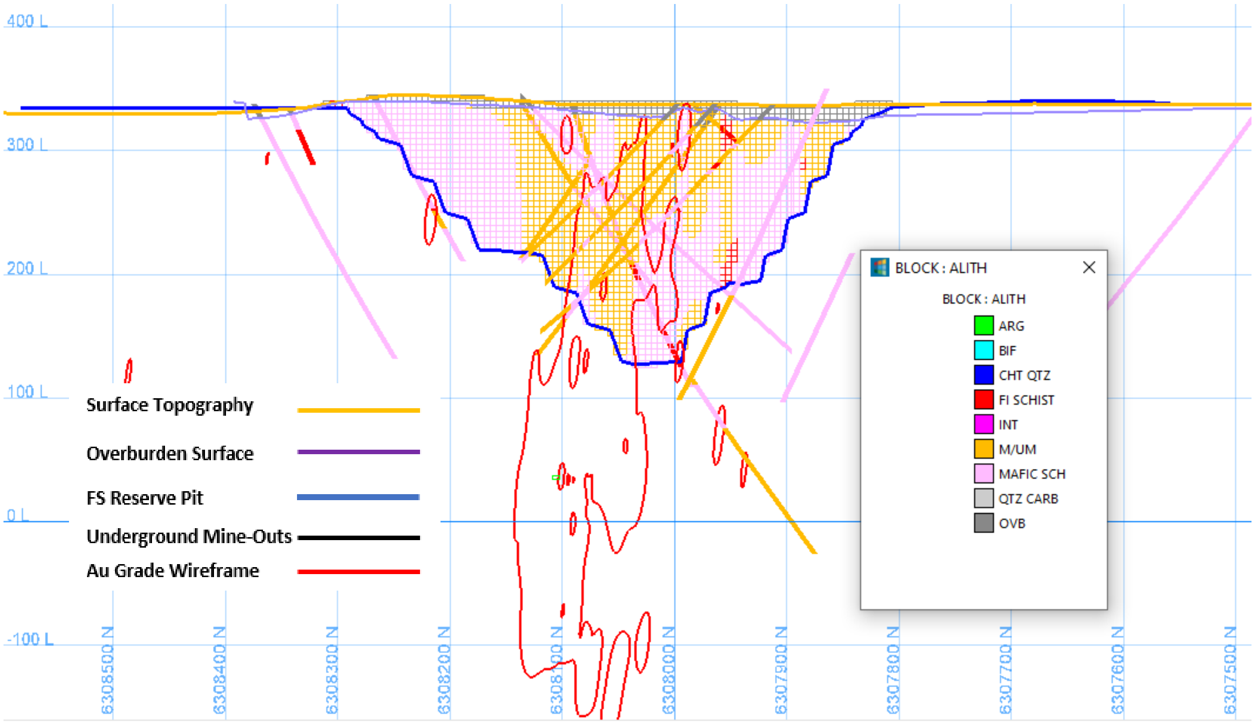


Figure IAAC-92-2k MacLellan Block Model: Lithology and Drillhole Lithology – Section 2

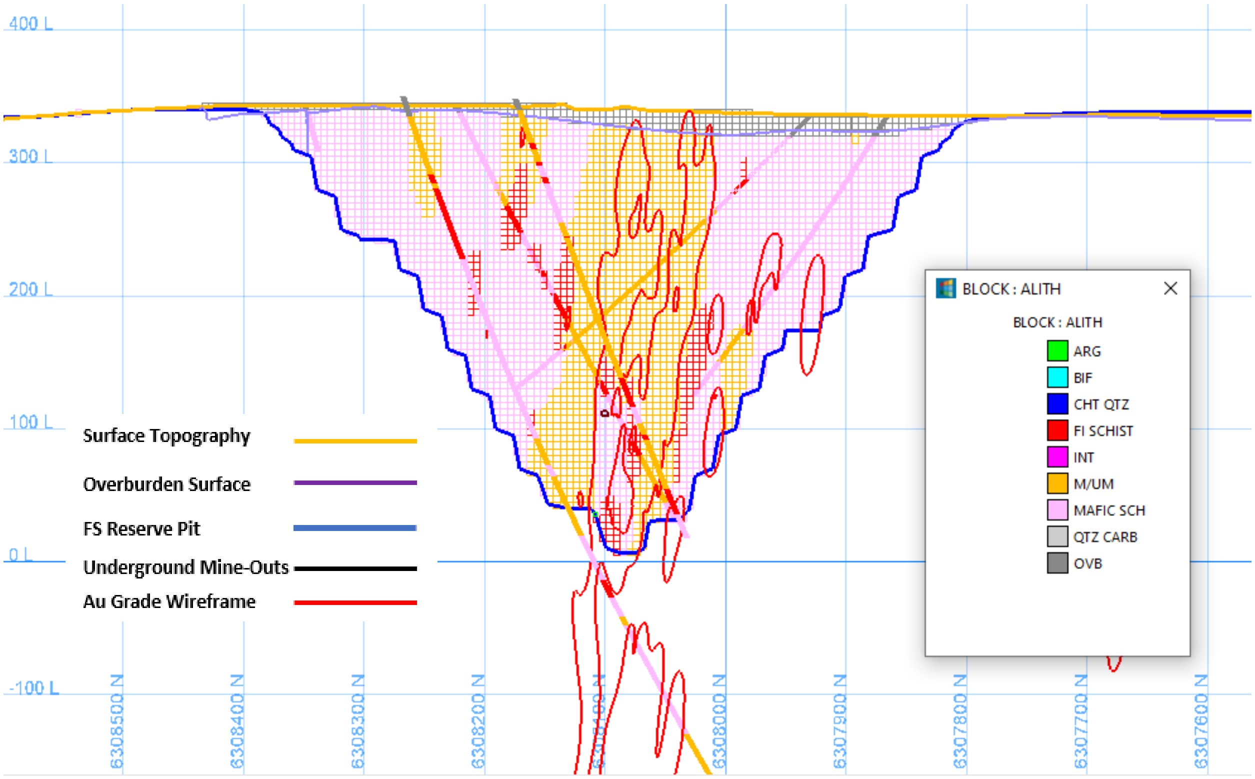


Figure IAAC-92-2I MacLellan Block Model: Lithology and Drillhole Lithology – Section 3

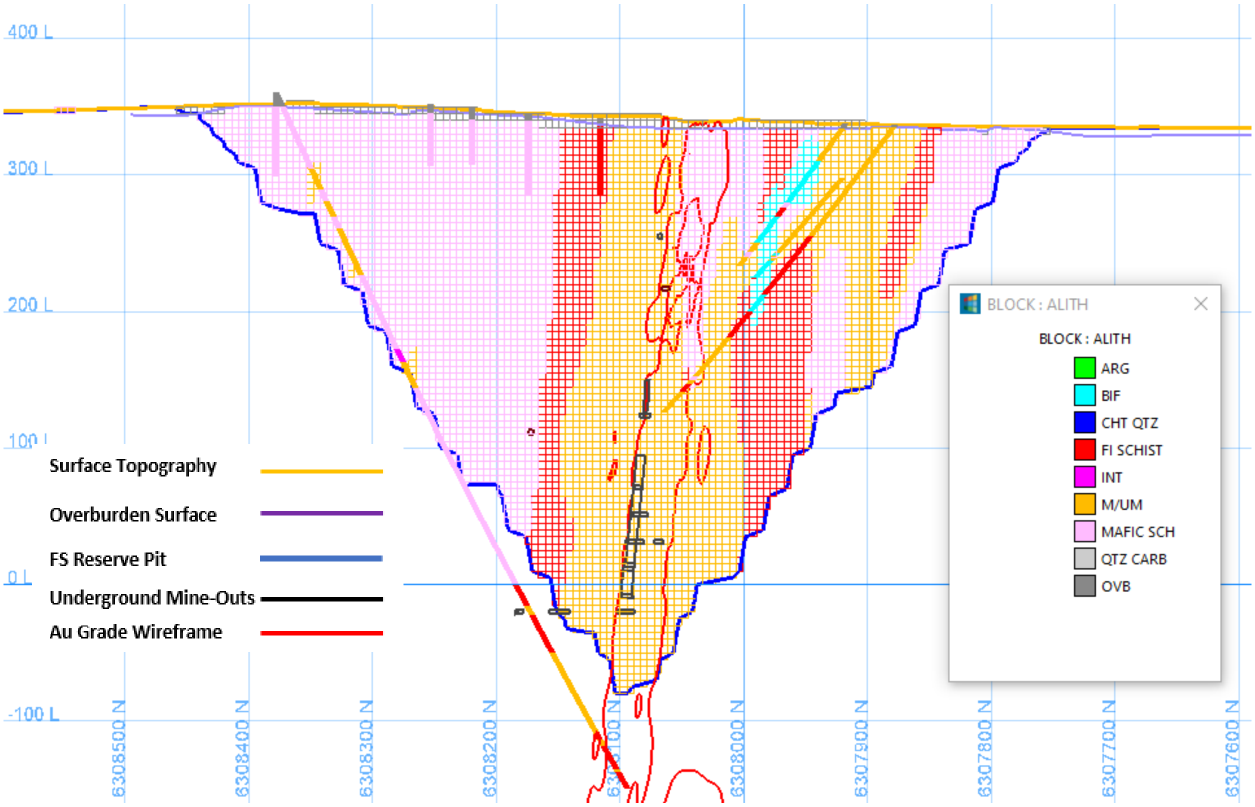


Figure IAAC-92-2m MacLellan Block Model: Lithology and Drillhole Lithology – Section 4

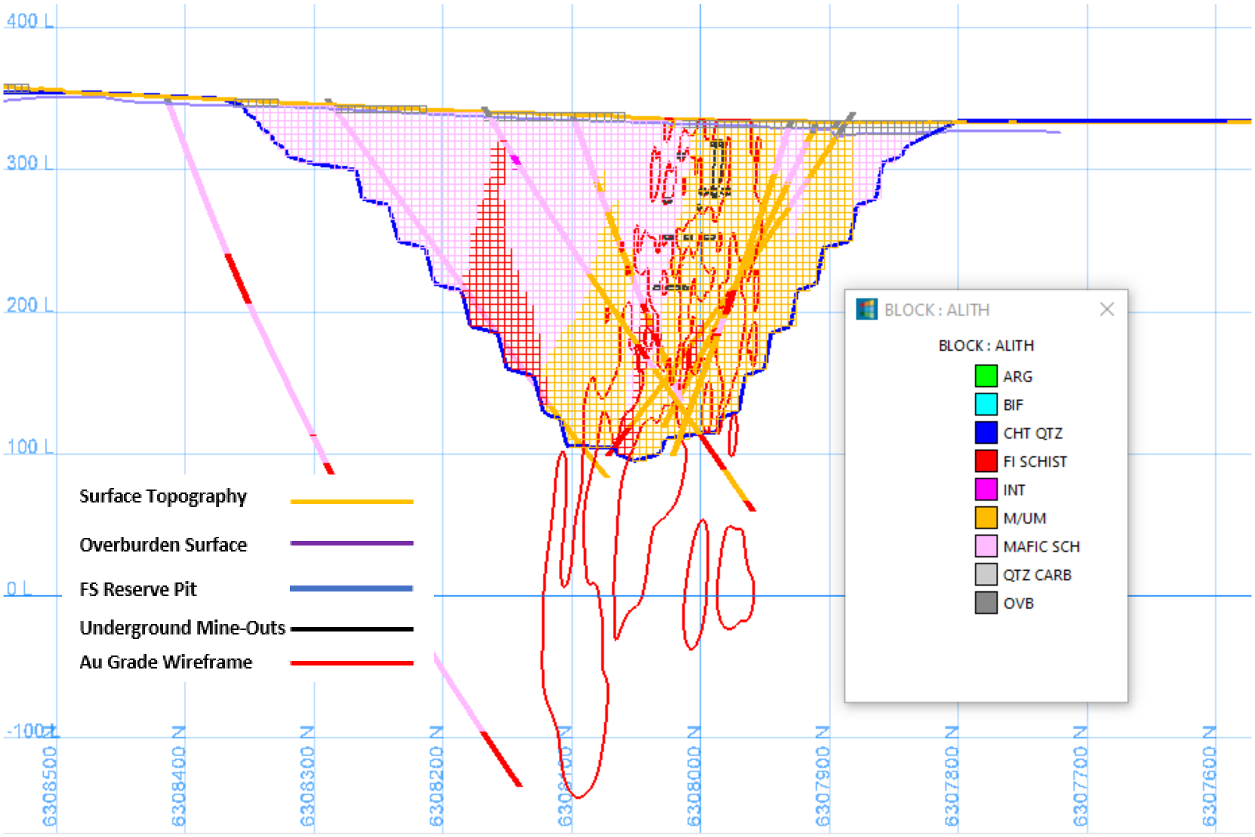


Figure IAAC-92-2n MacLellan Block Model: Lithology and Drillhole Lithology – Section 5

A.14 ATTACHMENT IAAC-95

Table IAAC-95-1: Summary of ABA statistics for individual samples compared to respecive composites samples (shown in *Italics*) from MacLellan Site

Parameter	ABA										
	Paste pH	S_{TOTAL}	$S_{SULPHATE}$	$S_{SULPHIDE}$	TIC	Mod. NP	Carb. NP	AP	NP	NNP	NPR
Units	pH units	wt. %				kgCaCO$_3$/t					unitless
Mine Rock, 160 samples											
25th, %ile	8.6	0.22	0.010	0.21	0.23	28	19	6.7	19	3.8	**0.88**
Median	8.8	0.66	0.010	0.65	0.55	54	45	21	44	29	2.7
Average	8.8	0.94	0.016	0.92	0.84	69	70	29	68	39	2.3
ML WR S>1%	8.8	1.8	-	-	0.82	72	68	57	68	11	**1.2**
ML WR AVG	8.9	1.0	-	-	0.66	65	55	31	55	24	**1.8**
Overburden, 25 samples											
25th, %ile	7.1	0.010	0.010	0	0.050	6.8	4.2	0.31	4.00	6.0	4.0
Median	8.2	0.020	0.010	0.010	0.050	11	4.2	0.63	4.0	9.5	13
Average	7.7	0.060	0.014	0.047	0.13	17	11	1.9	10	8.1	5.3
ML/FL Comp	8.2	0.070	-	-	0.025	-	2.0	2.2	14	-0.17	**0.92**
ML/FL Comp D	8.1	0.050	-	-	0.050	-	4.0	1.6	15	2.5	2.6
High Grade Ore, 36 samples											
25th, %ile	8.4	1.2	0.010	1.2	0.39	34	32	38	31	-59	**0.47**
Median	8.6	2.0	0.030	2.0	0.85	59	70	63	68	-14	**1.2**
Average	8.6	2.0	0.024	2.0	0.89	74	74	63	72	9.0	**1.1**
ML ORE	8.7	2.2	-	-	0.91	109.7	76	68	76	7.8	**1.1**
Tailings, 24 samples											
25th, %ile	8.6	1.0	0.15	0.86	0.76	80	64	32	62	33	**1.2**
Median	8.7	1.3	0.24	1.1	0.90	86	75	41	73	56	**1.9**
Average	8.7	1.5	0.23	1.2	0.97	92	81	46	78	32	**1.7**
CND 3P	8.9	1.7	-	-	0.63	92	53	53	52	-0.70	**1.0**
CND 5	9.1	1.3	-	-	0.75	100	63	39	63	24	**1.6**

Note: S_{TOTAL} = Total Sulphur; $S_{SULPHIDE}$ = Sulphide Sulphur; $S_{SULPHATE}$ = Sulphate Sulphur; TIC = Total Inorganic Carbon;
NP = Neutralization Potential; Mod. NP = Modified Sobek Neutralization Potential with Siderite correction;
Carb. NP = Carbonate Neutralization Potential; AP = Acid Generation Potential;
Reportable detection limits (RDLs) are used to calculate statistical parameters for values less than RDLs.
NNP = Net Neutralization Potential; NPR =Neutralization Potential Ratio; NPR values between 1 and 2 are bolded and below 1 are bolded and shaded. See text for assumptions and calculations;
Reportable detection limits (RDLs) have been used to calculate statistical parameters for values less than RDLs;
*All statistics including averages were calculated from values presented in Appendix G, excluding NNP and NPR;
Averages for NPR and NNP were calculated from average NP and AP (e.g. Average NPR=Average NP/Average AP);
Standart deviations for these values were calculated using propagation rules;
Values in cells highlighted yellow exceed either median or average value for the material;
Values in cells highlighted green are between the 25th percentile and average value for the material.

Table IAAC-95-2: Summary of SFE statistics for individual samples compared to the respecive composites samples (shown in *Italics*) from MacLellan Site

Parameter	Final pH*	Ag	Al	As	Be	B	Cd	Co	Cr	Cu	Fe	Hg*	Mo	Ni	Pb	Sb	Se	Tl	U	V	Zn
Units	pH units	mg/L																			
MMER	-	-	-	0.5	-	-	-	-	-	0.3	-	-	-	0.5	0.2	-	-	-	-	-	0.5
CWQG	6.5-8.5	0.00025	0.1	0.005	0.1	1.5	0.00009	0.05	0.001	0.002	0.3	0.00003	0.073	0.025	0.001		0.001	0.0008	0.015	0.1	0.03
Mine Rock, 160 samples																					
25th, %ile	**9.4**	0.00005	**0.25**	0.0025	0.0005	0.01	0.00002	0.0001	0.0005	0.0005	0.03	0.00002	0.00030	0.0005	0.0001	0.00050	0.0005	0.0001	0.00001	0.0030	0.005
Median	**9.5**	0.00010	**0.54**	**0.0069**	0.0005	0.01	0.00002	0.0001	0.0005	0.0005	0.03	0.00002	0.00060	0.0005	0.0001	0.0015	0.0005	0.0001	0.00001	0.0050	0.005
Average	**9.4**	0.00010	**0.53**	**0.026**	0.0005	0.013	0.00002	0.0003	0.0006	0.00068	0.047	0.00002	0.00088	0.0040	0.0002	0.0034	0.00051	0.0001	0.000065	0.0059	0.0053
ML WR AVG	**9.5**	<0.00005	**0.49**	**0.023**	<0.0005	<0.01	<0.00002	<0.0001	<0.0005	<0.0005	<0.03	<0.00002	0.0014	<0.0005	<0.0001	0.0023	<0.0005	<0.0001	0.00002	0.0060	<0.005
ML WR S>1%	**9.3**	<0.00005	**0.38**	**0.010**	<0.0005	<0.01	<0.00002	<0.0001	<0.0005	<0.0005	<0.03	<0.00002	0.0017	<0.0005	0.0002	0.0028	<0.0005	<0.0001	0.00001	0.0030	<0.005
Overburden, 25 samples																					
25th, %ile	6.8	0.00005	**0.13**	0.0008	0.0005	0.01	0.00002	0.0002	0.0005	**0.0032**	0.10	0.00002	0.0010	0.00070	0.0001	0.00010	0.0005	0.0001	0.00019	0.0010	0.005
Median	8.1	0.00005	**0.54**	0.0018	0.0005	0.01	0.00002	0.0002	0.0007	**0.0056**	**0.31**	0.00002	0.0032	0.00080	0.0005	0.00020	0.0006	0.0001	0.00029	0.0030	0.005
Average	7.6	0.00010	**9.2**	0.0030	0.00084	0.019	0.000039	0.0029	**0.011**	**0.012**	**6.5**	0.000022	0.0057	0.0079	**0.0057**	0.00042	**0.0012**	0.00018	0.00097	0.017	0.024
ML/FL Comp	-	<0.00005	0.056	<0.0005	<0.0005	<0.01	<0.00002	0.0001	<0.0005	**0.0032**	<0.03	<0.00002	0.0023	0.00090	0.0001	0.00010	<0.0005	<0.0001	0.0010	0.0020	<0.005
ML/FL Comp Dup	-	<0.00005	0.069	<0.0005	<0.0005	<0.01	<0.00002	0.0002	<0.0005	**0.0040**	<0.03	<0.00002	0.0032	0.0015	0.0001	0.00010	<0.0005	<0.0001	0.0015	0.0020	<0.005
High Grade Ore, 36 samples																					
25th, %ile	**9.3**	0.00005	**0.26**	**0.017**	0.0005	0.01	0.00002	0.0001	0.0005	0.0005	0.03	0.00002	0.00053	0.00050	0.00010	0.0024	0.0005	0.0001	0.00001	0.0020	0.005
Median	**9.4**	0.00010	**0.40**	**0.081**	0.0005	0.01	0.00002	0.0001	0.0005	0.0005	0.03	0.00002	0.00080	0.00080	0.00010	0.0061	0.0005	0.0001	0.00001	0.0040	0.005
Average	**9.3**	0.00010	**0.41**	**0.16**	0.0005	0.013	0.00002	0.00011	0.00059	0.00053	0.035	0.00002	0.00086	0.0012	**0.0016**	0.023	0.0005	0.0001	0.000019	0.0041	0.005
ML ORE	**9.3**	<0.00005	**0.36**	**0.26**	<0.0005	<0.01	<0.00002	<0.0001	<0.0005	<0.0005	<0.03	<0.00002	0.0017	<0.0005	0.0002	0.022	<0.0005	<0.0001	<0.00001	0.0030	<0.005
Tailings, 24 samples																					
25th, %ile	**8.8**	0.000004	0.079	**0.027**	0.000007	0.011	0.000003	0.0052	0.000078	0.00036	0.070	0.00001	0.00069	0.00038	0.000038	0.0034	0.00014	0.000020	0.000016	0.00060	0.002
Median	**9.0**	0.000013	**0.13**	**0.12**	0.000007	0.017	0.000005	0.011	0.00029	0.00042	0.086	0.00001	0.00084	0.00055	0.00010	0.0062	0.00018	0.000026	0.000039	0.00082	0.002
Average	**8.9**	0.000022	**0.15**	**0.22**	0.000007	0.031	0.000006	0.012	0.00036	0.00059	0.089	0.00001	0.00093	0.00085	0.00037	0.020	0.00022	0.000027	0.000062	0.0010	0.002
CND 3P	**8.6**	0.000091	**0.10**	**0.085**	< 0.000007	0.0075	0.000015	0.0035	0.00015	**0.0054**	0.067	< 0.00001	0.0020	0.0037	0.00021	0.041	0.00030	< 0.000005	0.000068	0.00019	< 0.002
CND 5	**8.7**	0.000024	0.091	**0.016**	< 0.000007	0.0069	0.000003	0.012	0.00028	**0.0048**	0.14	< 0.00001	0.0020	0.0062	0.00003	0.0046	0.00023	< 0.000005	0.000147	0.00018	< 0.002

Note: Reportable detection limits (RDLs) are used to calculate statistical parameters for values less than RDLs.* - Total number of samples tested for pH and Hg are 7 for low- and 20 for high grade ores.

Guidelines, Canadian Water Quality Guidelines for the Protection of Aquatic Life - Freshwater Aquatics Long Term (CCME, 2002); Values above CWQG guidelines are bolded; Values above CWQG and MMER guidelines are bolded and underlined (See text for selection of CWQG guidelines); Reportable detection limits (RDLs) have been used to calculate statistical parameters for values less than RDLs.

Values in cells highlighted yellow exceed either median or average value for the material. Values in cells highlighted green are between the 25th percentile and average value for the material.

Table IAAC-95-3: Summary of statistics for total concentration of trace elements for individual samples compared to the respecive composites samples (shown in *Italics*) from MacLellan Site

Parameter	Ag	Al	As	Be	Cd	Co	Cr	Cu	Fe	Hg*	Mo	Ni	Pb	Se	Tl	U	V	Zn
Units	ppm																	
ACUC×10	530	407639	48	21	0.9	173	920	280	320415	0.5	11	470	170	0.9	9	27	970	670
Mine Rock, 160 samples																		
25th, %ile	0.16	19000	1.9	0.050	0.060	23	24	70	33000	0.0040	0.24	24	1.6	0.30	0.019	0.041	54	45
Median	0.35	26000	6.7	0.090	0.13	40	100	110	41000	0.0040	0.43	93	3.9	0.50	0.11	0.085	84	76
Average	0.70	31000	91	0.17	1.1	42	220	140	47000	0.0050	0.68	250	29	0.69	0.17	0.26	110	110
ML WR AVG	0.71	33700	55	0.21	0.23	40	217	157	46700	<0.004	1.0	225	11	0.73	0.20	0.35	118	97
ML WR S>1%	1.3	30400	33	0.18	4.5	51	222	168	57267	0.0067	0.94	306	52	0.87	0.22	0.26	121	534
Overburden, 25 samples																		
25th, %ile	0.032	5000	0.69	0.15	0.027	2.4	11	7.6	9700	0.0040	0.37	0.052	3.6	0.30	0.075	0.90	13	19
Median	0.039	6900	1.6	0.18	0.041	3.7	17	13	13000	0.0040	0.49	0.056	5.3	0.40	0.13	1.1	21	32
Average	0.51	9400	5.8	0.27	0.094	5.3	25	21	16000	0.0086	1.5	0.068	31	0.46	0.17	1.1	28	61
ML/FL Comp	1.1	16000	0.79	0.18	0.043	8.0	33	29	24200	<0.004	1.0	16	9.6	0.20	0.29	1.1	42	57
ML/FL Comp Dup	1.3	14100	0.78	0.25	0.049	7.3	35	20	23000	<0.004	0.73	16	6.9	0.40	0.30	1.1	39	56
High Grade Ore, 36 samples																		
25th, %ile	1.9	24000	120	0.078	0.36	48	110	120	55000	0.0040	0.35	140	27	0.70	0.077	0.075	58	160
Median	4.2	42000	820	0.63	30	61	230	190	66000	0.0045	0.95	320	140	1.1	0.45	0.24	150	470
Average	8.3	44000	2300	1.0	21	60	280	220	68000	0.029	2.9	380	440	14	13	13	130	1300
ML ORE	8.4	34000	5257	0.25	9.7	49	202	204	53300	0.081	0.5	354	310	0.73	0.21	0.13	90	1137
Tailings, 24 samples																		
25th, %ile	1.0	46000	53	0.12	0.69	38	170	76	78000	0.050	0.8	170	24	0.70	0.17	0.13	130	280
Median	1.2	59000	730	0.25	2.6	50	290	97	85000	0.050	1.0	350	170	0.70	0.24	0.19	170	520
Average	2.3	58000	980	0.33	5.3	48	380	110	83000	0.057	1.2	370	260	0.70	0.30	0.46	160	740
CND 3P	3.8	57000	1500	0.46	8.3	56	420	390	81000	< 0.05	2.3	370	400	1.6	0.24	0.45	150	1100
CND 5	1.2	54000	130	0.39	1.5	68	510	290	84000	< 0.05	1.7	470	48	2.1	0.18	0.52	170	340

Note: ACUC - Average Concentration in the Upper Crust of the Earth based on Rudnick and Gao (2004); Values exceeding 10x - Average Concentration in the Upper Crust are underlined;

Reportable detection limits (RDLs) are used to calculate statistical parameters for values less than RDLs.* - Total number of samples tested for Hg are 7 for low- and 20 for high grade ores.

Values in cells highlighted yellow exceed either median or average value for the material. Values in cells highlighted green are between the 25th percentile and average value for the material

Table IAAC-95-4: Summary of ABA statistics for individual samples compared to respecive composites samples (shown in *Italics*) from Gordon Site

Parameter	ABA										
	Paste pH	S_{TOTAL}	$S_{SULPHATE}$	$S_{SULPHIDE}$	TIC	Mod. NP	Carb. NP	AP	NP	NNP	NPR
Units	pH units	wt. %				kgCaCO$_3$/t					unitless
Igneous Rock, 81 sample (I1b, I2a, I3a, I3c, I4a, V1b, V2a)											
25th, %ile	8.7	0.020	0.020	0	0.45	44	38	0.63	36	32	7.1
Median	9.0	0.090	0.090	0.070	0.70	68	58	2.8	56	52	19
Average	8.9	0.24	0.24	0.22	0.82	73	68	7.4	66	59	8.9
FL I1 and I2	9.0	0.26	-	-	0.67	64	56	8.0	56	48	7.0
FL I3A	8.9	0.15	-	-	1.1	128	92	4.6	92	87	20
FL I3C	9.0	0.13	-	-	1.3	135	110	4.0	110	106	28
Argillite, 11 samples (S2c)											
25th, %ile	9.1	0.26	0.26	0.25	0.050	9	4.2	8.1	4	-10	**0.28**
Median	9.1	0.29	0.29	0.28	0.050	10	4.2	9.1	4	-4.1	**0.50**
Average	9.0	0.34	0.34	0.33	0.15	15	12	11	12	1.0	**1.1**
FL S2C	9.1	0.36	-	-	0.14	18	12	11	12	0.60	**1.1**
BIF and Mafic Sediments, 50 samples (S3a, S5e, S5f, S5i, S5j)											
25th, %ile	8.5	0.060	0.060	0.04	0.18	22	15	1.9	15	10	3.7
Median	8.9	0.12	0.12	0.11	0.28	29	23	3.6	23	20	5.9
Average	8.9	0.18	0.18	0.17	0.34	34	29	5.6	28	22	5.0
FL S3A	9.9	0.17	-	-	0.32	39	27	5.4	27	21	4.9
FL S5FI	9.2	0.18	-	-	0.34	38	28	5.6	28	23	5.0
FL S5J	9.5	0.26	-	-	0.3	36	23	8.2	23	15	2.8
High Grade Ore, 28 samples											
25th, %ile	8.1	1.3	1.3	1.3	0.21	18	17	40	17	-93	**0.13**
Median	8.4	2.5	2.5	2.5	0.28	19	23	78	23	-36	**0.40**
Average	8.2	3.5	3.5	3.5	0.40	28	33	110	32	-78	**0.29**
FL ORE	8.7	3.1	-	-	0.27	33	23	97	23	-74	**0.23**
Tailings, 17 samples											
25th, %ile	8.2	0.99	0.99	0.81	0.34	30	28	31	27	-50	**0.48**
Median	8.4	1.9	1.9	1.9	0.43	39	36	60	35	-24	**0.59**
Average	8.4	2.0	2.0	1.9	0.56	44	47	62	46	-16	**0.74**
CND 4P	8.7	2.1	-	-	0.2	42	17	66	17	-49.30	**0.3**
CND 6	9.0	0.68	-	-	0.35	48	29	21	29	7.9	**1.4**

Note: S_{TOTAL} = Total Sulphur; $S_{SULPHIDE}$ = Sulphide Sulphur; $S_{SULPHATE}$ = Sulphate Sulphur; TIC = Total Inorganic Carbon;
NP = Neutralization Potential; Mod. NP = Modified Sobek Neutralization Potential with Siderite correction;
Carb. NP = Carbonate Neutralization Potential; AP = Acid Generation Potential;
Reportable detection limits (RDLs) are used to calculate statistical parameters for values less than RDLs.
NNP = Net Neutralization Potential; NPR =Neutralization Potential Ratio; NPR values between 1 and 2 are bolded and below 1 are bolded and shaded. See text for assumptions and calculations;
All statistics including averages were calculated from values presented in Appendix F, excluding NNP and NPR;
Averages for NPR and NNP were calculated from average NP and AP (e.g. Average NPR=Average NP/Average AP).
Standard deviations for these values were calculated using propagation rules; S3a=Mafic Sediments, S5e=Chl-chrt-antho-BIF, S5f=Cherty-antho-BIF, S5i=Chl-BIF, S5j=Chl-antho-BIF.
Values in cells highlighted yellow exceed either median or average value for the material;
Values in cells highlighted green are between the 25th percentile and average value for the material.

Table IAAC-95-5: Summary of SFE statistics for individual samples compared to the respecive composites samples (shown in *Italics*) from Gordon Site

Parameter	Final pH	Ag	Al	As	Be	B	Cd	Co	Cr	Cu	Fe	Hg	Mo	Ni	Pb	Sb	Se	Tl	U	V	Zn
Units	pH unit	mg/L																			
MMER	-	-	-	0.5	-	-	-	-	-	0.3	-	-	-	0.5	0.2	-	-	-	-	-	0.5
CCME	6.5-8.5	0.00025	0.1	0.005	0.1	1.5	0.00009	0.05	0.001	0.002	0.3	0.00003	0.073	0.025	0.001		0.001	0.0008	0.015	0.1	0.03
Igneous Rock, 81 sample (I1b, I2a, I3a, I3c, I4a, V1b, V2a)																					
25th, %ile	**9.4**	0.00010	**0.56**	0.00090	0.0005	0.01	0.00002	0.0001	0.0005	0.0005	0.03	0.00002	0.0003	0.0005	0.0001	0.00040	0.0005	0.0001	0.00001	0.002	0.005
Median	**9.5**	0.00010	**0.73**	0.0015	0.0005	0.01	0.00002	0.0001	0.0005	0.0005	0.03	0.00002	0.0006	0.0005	0.0001	0.00080	0.0005	0.0001	0.00003	0.004	0.005
Average	**9.4**	0.00014	**0.67**	0.0026	0.0005	0.013	0.00002	0.00011	0.0005	0.00053	0.041	0.00002	0.0011	0.00059	0.0001	0.00090	0.00051	0.0001	0.0001	0.005	0.005
FL I1+I2	**9.5**	<0.00005	**0.51**	**0.0022**	<0.0005	<0.01	<0.00002	<0.0001	<0.0005	<0.0005	<0.03	<0.00002	**0.00090**	<0.0005	<0.0001	**0.00040**	<0.0005	<0.0001	**0.00004**	**0.003**	<0.005
FL I3a	**9.4**	<0.00005	**0.13**	**0.0017**	<0.0005	<0.01	<0.00002	<0.0001	<0.0005	<0.0005	<0.03	<0.00002	**0.0011**	<0.0005	<0.0001	**0.00020**	<0.0005	<0.0001	<0.00001	**0.009**	<0.005
FL I3c	**9.4**	<0.00005	**0.55**	**0.0016**	<0.0005	<0.01	<0.00002	<0.0001	<0.0005	<0.0005	<0.03	<0.00002	**0.00070**	<0.0005	<0.0001	**0.0010**	<0.0005	<0.0001	<0.00001	**0.003**	<0.005
Argillite, 11 samples (S2c)																					
25th, %ile	**9.4**	0.00005	**1.0**	**0.0053**	0.0005	0.01	0.00002	0.0001	0.0005	0.0005	0.04	0.00002	0.0016	0.0005	0.0001	0.0012	0.0005	0.0001	0.00009	0.004	0.005
Median	**9.4**	0.00010	**1.2**	**0.0064**	0.0005	0.01	0.00002	0.0001	0.0005	0.0005	0.09	0.00002	0.0023	0.0005	0.0001	0.0014	0.0005	0.0001	0.00025	0.006	0.005
Average	**9.4**	0.000082	**1.1**	**0.012**	0.0005	0.012	0.00002	0.0001	0.0006	0.00052	0.10	0.00002	0.0038	0.0005	0.0001	0.0016	0.00051	0.0001	0.00021	0.005	0.005
FL S2c	**9.4**	<0.00005	**0.84**	**0.0098**	<0.0005	<0.01	<0.00002	<0.0001	<0.0005	<0.0005	**0.03**	<0.00002	**0.0027**	<0.0005	<0.0001	**0.0014**	<0.0005	<0.0001	**0.00011**	**0.004**	<0.005
BIF and Mafic Sediments, 50 samples (S3a, S5e, S5f, S5i, S5j)																					
25th, %ile	**9.5**	0.00005	**0.36**	0.0030	0.0005	0.02	0.00002	0.0001	0.0005	0.0005	0.035	0.00002	0.00040	0.0005	0.0001	0.00040	0.0005	0.0001	0.000043	0.001	0.005
Median	**9.9**	0.00010	**0.60**	**0.0070**	0.0005	0.02	0.00002	0.0001	0.0005	0.0005	0.12	0.00002	0.00055	0.0005	0.0001	0.00070	0.0005	0.0001	0.00009	0.002	0.005
Average	**9.9**	0.00011	**0.65**	**0.017**	0.0005	0.029	0.00002	0.0001	0.0005	0.00052	0.21	0.00002	0.00092	0.0005	0.0001	0.00075	0.00061	0.0001	0.00014	0.002	0.005
FL S3a	**10.5**	<0.00005	**1.1**	**0.0071**	<0.0005	**0.02**	<0.00002	<0.0001	<0.0005	<0.0005	**0.43**	<0.00002	**0.00070**	<0.0005	<0.0001	**0.00060**	<0.0005	<0.0001	**0.00009**	**0.003**	<0.005
FL S5fi	**9.8**	<0.00005	**0.44**	**0.010**	<0.0005	**0.02**	<0.00002	<0.0001	<0.0005	<0.0005	**0.080**	<0.00002	**0.00080**	<0.0005	<0.0001	**0.00040**	<0.0005	<0.0001	**0.00009**	**0.001**	<0.005
FL S5j	**10**	<0.00005	**0.77**	**0.021**	<0.0005	**0.02**	<0.00002	<0.0001	<0.0005	<0.0005	**0.74**	<0.00002	**0.00090**	<0.0005	<0.0001	**0.00050**	**0.0005**	<0.0001	**0.00019**	**0.003**	<0.005
High Grade Ore, 15 samples																					
25th, %ile	**8.8**	0.00005	0.096	0.00050	0.0005	0.01	0.00002	0.0001	0.0005	0.0005	0.030	0.00002	0.0003	0.0005	0.0001	0.00020	0.0005	0.0001	0.00004	0.001	0.005
Median	**9.2**	0.00010	**0.35**	0.00090	0.0005	0.03	0.00002	0.0001	0.0005	0.0005	0.080	0.00002	0.0005	0.0005	0.0001	0.00030	0.0005	0.0001	0.00007	0.001	0.005
Average	**8.9**	0.000093	**0.41**	0.0039	0.0005	0.054	0.000026	0.0017	0.00063	0.0005	0.18	0.00002	0.0040	0.0025	0.00011	0.00042	0.00056	0.0001	0.00012	0.002	0.005
FL ORE	**9**	<0.00005	**0.31**	**0.0018**	<0.0005	**0.03**	<0.00002	<0.0001	<0.0005	<0.0005	**0.07**	<0.00002	**0.0022**	<0.0005	<0.0001	**0.00030**	<0.0005	<0.0001	**0.00017**	<0.001	<0.005
Tailings, 17 samples																					
25th, %ile	**8.7**	0.000002	0.063	0.00040	0.000007	0.016	0.000003	0.0011	0.00003	0.00035	0.12	0.00001	0.0011	0.00010	0.000020	0.00060	0.00011	0.000017	0.00019	0.00005	0.002
Median	**8.8**	0.000003	0.084	0.00080	0.000007	0.022	0.000004	0.0018	0.00003	0.00043	0.24	0.00001	0.0012	0.00010	0.000020	0.00070	0.00018	0.000022	0.00022	0.00011	0.002
Average	**8.8**	0.000013	**0.11**	**0.011**	0.000007	0.039	0.000006	0.0029	0.00021	0.00053	0.21	0.00001	0.0014	0.00025	0.000045	0.0016	0.00023	0.000021	0.00043	0.00073	0.002
CND 4P	**8.5**	**0.000056**	**0.09**	**0.00060**	< 0.000007	**0.0165**	< 0.000003	**0.000453**	**0.00012**	**0.015**	**0.047**	< 0.00001	**0.0025**	**0.00010**	**0.000040**	**0.0012**	**0.00037**	< 0.000005	**0.00129**	**0.00007**	< 0.002
CND 6	**8.9**	**0.000030**	**0.25**	**0.0037**	< 0.000007	**0.0136**	**0.000003**	**0.0057**	**0.00016**	**0.0051**	**0.80**	< 0.00001	**0.0047**	**0.00020**	**0.000010**	**0.0024**	**0.00073**	< 0.000005	**0.0017**	**0.00039**	< 0.002

Note: SFE –Shake Flask Extraction; St. Dev. = Standard Deviation; MMER - Metal Mining Effluent Regulation, authorized limits of deleterious substances in a grab sample (SOR/2002-222); CWQG - Canadian Environmental Quality Guidelines, Canadian Water Quality Guidelines for the Protection of Aquatic Life - Freshwater Aquatics Long Term (CCME, 2002); Values above CWQG guidelines are bolded; Values above CWQG and MMER guidelines are bolded and underlined (see text for selection of CWQG guidelines); Reportable detection limits (RDLs) have been used to calculate statistical parameters for values less than RDLs.

I1b=Granodiorite, I2a=Diorite, I3a=Gabbro, I3c=Mafic/Intermediate Dyke, I4a=Pyroxenite, V1b=Dacite, V2a=Andesite

S3a=Mafic Sediments, S5e=Chl-chrt-antho-BIF , S5f=Cherty-antho-BIF , S5i=Chl-BIF, S5j=Chl-antho-BIF.

Values in cells highlighted yellow exceed either median or average value for the material. Values in cells highlighted green are between the 25th percentile and average value for the material.

Table IAAC-95-6: Summary of statistics for total concentration of trace elements for individual samples compared to the respecive composites samples (shown in *Italics*) from Gordon Site

Parameter	Ag*	Al	As*	Be	Cd	Co	Cr	Cu*	Fe	Hg	Mo	Ni	Pb	Se	Tl	U	V	Zn
Units	ppm																	
10xACUC	530	407639	48	21	0.9	173	920	280	320415	0.5	11	470	170	0.9	9	27	970	670
Igneous Rock, 81 sample (I1b, I2a, I3a, I3c, I4a, V1b, V2a)																		
25th, %ile	0.031	24000	1.6	0.13	0.028	17	19	21	41000	0.0040	0.38	16	1.0	0.40	0.038	0.22	74	61
Median	0.050	27000	2.2	0.27	0.041	23	63	36	55000	0.0040	0.61	46	1.8	0.40	0.086	0.43	100	71
Average	0.081	27000	5.7	0.28	0.0520	22	70	49	55000	0.0045	0.75	41	2.6	0.49	0.11	0.89	100	70
FL I1+I2	0.079	27033	5.8	0.22	0.051	20	59	55	52433	<0.004	0.6	35	2.2	0.43	0.12	1.1	92	76
FL I3a	0.085	26367	2.1	0.12	0.027	26	234	60	37700	<0.004	0.14	111	0.87	0.40	0.11	0.20	122	45
FL I3c	0.052	28067	16	0.38	0.058	25	60	24	68367	0.0040	0.74	43	3.5	0.47	0.051	0.22	141	71
Argillite, 11 samples (S2c)																		
25th, %ile	0.035	24000	16	0.19	0.0095	12	110	23	45000	0.004	2	40	2.5	0.50	0.15	1.7	84	79
Median	0.039	26000	41	0.21	0.018	14	150	28	48000	0.004	4.2	81	3.2	0.60	0.19	2.5	94	85
Average	0.0590	29000	83	0.46	0.021	13	130	28	58000	0.0044	3.7	64	3.6	0.65	0.18	2.4	91	78
FL S2c	0.062	28133	66	0.35	0.050	13	143	31	56400	0.005	4.0	73	4.1	0.47	0.19	2.0	87	93
BIF and Mafic Sediments, 50 samples (S3a, S5e, S5f, S5i, S5j)																		
25th, %ile	0.018	12000	13	0.8	0.006	4.4	18	6.7	120000	0.004	0.44	6.5	1.6	0.30	0.040	0.26	29	6.3
Median	0.023	16000	27	0.97	0.018	6.9	27	9.1	140000	0.004	0.57	13	2.2	0.40	0.064	0.36	42	12
Average	0.048	17000	72	1.0	0.023	7.4	32	15	150000	0.0042	0.65	13	2.3	0.47	0.064	0.37	43	14
FL S3a	0.042	25467	17	1.1	0.022	8.7	56	11	127000	<0.004	0.5	18	3.0	0.33	0.086	0.39	48	19
FL S5fi	0.029	15100	70	0.86	0.024	6.1	25	11	157167	<0.004	0.65	11	2.3	0.47	0.054	0.32	38	12
FL S5j	0.051	17533	53	0.97	0.028	7.1	34	49	155333	<0.004	0.65	12	2.1	0.40	0.055	0.34	38	12
High Grade Ore, 28 samples																		
25th, %ile	0.50	12000	5.0	0.41	0.014	9.3	18	50	140000	0.0040	0.25	13	3.6	0.50	0.084	0.33	37	19
Median	0.65	20000	10	0.57	0.032	10	35	100	190000	0.0060	0.27	17	4.7	0.90	0.16	0.40	46	28
Average	0.96	18000	12	0.68	0.038	12	47	150	170000	0.0160	1.6	23	5.3	0.95	0.16	0.88	57	31
FL ORE	0.70	19633	11	0.49	0.028	11	57	100	145833	0.010	1.4	30	5.1	0.70	0.17	1.3	60	34
Tailings, 17 samples																		
25th, %ile	0.12	20000	6.6	0.67	0.090	10	72	30	84000	0.05	0.80	31	3.8	0.7	0.18	0.46	36	49
Median	0.16	23000	15	0.92	0.12	11	78	51	200000	0.05	1.1	41	4.5	0.7	0.22	0.51	64	56
Average	0.36	35000	21	0.86	0.44	15	110	76	170000	0.05	2.1	67	12	0.7	0.21	1.4	84	100
CND 4P	0.39	36000	19	1.1	0.17	13	110	430	170000	< 0.05	3.4	40	7.1	< 0.7	0.15	1.6	83	62
CND 6	0.22	55000	33	1.0	0.12	13	130	280	120000	< 0.05	4.1	54	6.5	1.1	0.17	2.5	120	77

Note: * - Total number of samples tested for Ag, As, and Cu for low and high grade ore are 7 and 28, respectively;
ACUC - Average Concentration in the Upper Crust of the Earth based on Rudnick and Gao (2004); Values exceeding 10x - Average Concentration in the Upper Crust are underlined;
Reportable detection limits (RDLs) have been used to calculate statistical parameters for values less than RDLs
I1b=Granodiorite, I2a=Diorite, I3a=Gabbro, I3c=Mafic/Intermediate Dyke, I4a=Pyroxenite, V1b=Dacite, V2a=Andesite
S3a=Mafic Sediments, S5e=Chl-chrt-antho-BIF , S5f=Cherty-antho-BIF , S5i=Chl-BIF, S5j=Chl-antho-BIF
Values in cells highlighted yellow exceed either median or average value for the material. Values in cells highlighted green are between the 25th percentile and average value for the material.

A.15 ATTACHMENT IAAC-96

Table IAAC-96-1 Modified Sobek ABA with Siderite Correction

Parameter	Unit	Global Comp	MCL-OG-MC	MCL-LG-MC	FL-OG-MC	FL-LG-MC	CN 29 Residue	CN 30 Residue	CN 31 Residue	CN 32 Residue	CN 33 Residue
Description		Ore	Ore	Ore	Ore	Ore	MCL-OG	MCL-OG	MCL-OG	MCL-OG	MCL-OG
LIMS		15162-JUL15	15162-JUL15	15162-JUL15	15162-JUL15	15162-JUL15	13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15
Paste pH	unit	9.36	9.49	9.37	9.08	9.37	8.56	8.35	8.79	8.70	8.47
Fizz Rate	---	4	4	4	2	3	4	4	4	3	4
Sample weight	g	2.01	2.03	2.03	1.99	2.01	1.94	1.96	2.09	1.96	2.15
HCl_add	mL	74.10	82.00	83.50	47.30	42.20	40.00	40.00	86.50	20.00	57.20
HCl	Normality	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
NaOH	Normality	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Vol NaOH	mL to pH=8.3	35.23	34.21	33.01	22.26	17.16	8.74	7.78	25.65	2.76	13.68
Final pH	unit	1.81	1.75	1.70	1.88	2.09	1.68	2.02	1.78	2.12	1.85
NP	t $CaCO_3$/1000 t	69	91	98	38	44	75	78	131	38	94
AP	t $CaCO_3$/1000 t	47.5	40.6	30.3	64.7	20.9	39.4	32.2	30.3	56.9	79.7
Net NP	t $CaCO_3$/1000 t	21.5	50.4	67.7	-26.69	23.1	35.6	45.8	101	-18.88	14.3
NP/AP	ratio	1.45	2.24	3.23	0.59	2.10	1.90	2.42	4.32	0.67	1.18
S	%	1.80	1.64	1.37	2.06	0.708	1.59	1.06	1.21	2.17	2.80
Acid Leachable SO_4-S	%	0.28	0.34	0.40	< 0.01	0.04	0.33	0.03	0.24	0.35	0.25
Sulphide	%	1.52	1.30	0.97	2.07	0.67	1.26	1.03	0.97	1.82	2.55
C	%	0.800	1.02	1.13	0.521	0.633	0.715	0.892	1.74	0.396	0.943
CO_3	%	2.43	3.67	3.96	1.24	2.00	3.08	3.52	7.77	1.54	3.89
CO_3 NP	t $CaCO_3$/1000 t	40.3	60.9	65.7	20.6	33.2	51.1	58.4	129.0	25.6	64.6
CO_3 Net NP	t $CaCO_3$/1000 t	-7.2	20.3	35.4	-44.1	12.3	11.7	26.2	98.7	-31.3	-15.1
CO_3 NP/AP	ratio	0.85	1.50	2.17	0.32	1.59	1.30	1.81	4.26	0.45	0.81
NP attributed to CO_3	%	58.5	66.9	67.1	54.2	75.5	68.2	74.9	98.5	67.3	68.7

Net Acid Generation

Parameter	Unit	Global Comp	MCL-OG-MC	MCL-LG-MC	FL-OG-MC	FL-LG-MC	CN 29 Residue	CN 30 Residue	CN 31 Residue	CN 32 Residue	CN 33 Residue
Description		Ore	Ore	Ore	Ore	Ore	MCL-OG	MCL-OG	MCL-OG	MCL-OG	MCL-OG
LIMS		15163-JUL15	15163-JUL15	15163-JUL15	15163-JUL15	15163-JUL15	13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15
Sample weight	g	1.51	1.50	1.50	1.47	1.52	1.47	1.50	1.53	1.50	1.51
Vol H_2O_2	mL	150	150	150	150	150	150	150	150	150	150
Final pH	unit	7.89	8.57	8.65	3.05	9.97	9.08	9.80	9.43	8.07	8.98
NaOH	Normality	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Vol NaOH to pH 4.5	mL	0.00	0.00	0.00	2.41	0.00	0.00	0.00	0.00	0.00	0.00
Vol NaOH to pH 7.0	mL	0.00	0.00	0.00	3.54	0.00	0.00	0.00	0.00	0.00	0.00
NAG (pH 4.5)	kg H_2SO_4/tonne	0	0	0	8	0	0	0	0	0	0
NAG (pH 7.0)	kg H_2SO_4/tonne	0	0	0	12	0	0	0	0	0	0
SO_4	mg/L	490	420	430	880	220	---	---	---	---	---

SO_4	%	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	---	---	---	---	---

Table IAAC-96-1 Modified Sobek ABA with Siderite Correction

Parameter	Unit	CN 34 Residue	CN 35 Residue	CN 36 Residue	CN 37 Residue	CN 38 Residue	CN 39 Residue	CN 40 Residue	CN 41 Residue	CN 42 Residue	CN 43 Residue
Description		MCL-OG	MCL-OG	MCL-OG	MCL-OG	MCL-OG	MCL-OG	MCL-OG	MCL-OG	MCL-OG	MCL-OG
LIMS		13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15
Paste pH	unit	8.51	8.62	8.89	8.63	8.57	8.83	8.94	8.97	8.85	8.48
Fizz Rate	---	4	4	3	4	4	4	4	3	3	3
Sample weight	g	2.13	1.9	1.98	2.05	2.03	1.97	1.91	2	1.82	2.08
HCl_add	mL	93.00	69.60	26.30	101.50	82.50	70.10	71.80	28.60	64.30	75.70
HCl	Normality	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
NaOH	Normality	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Vol NaOH	mL to pH=8.3	23.41	31.32	3.96	35.78	25.60	29.77	32.44	12.02	26.80	32.50
Final pH	unit	1.83	1.68	1.69	1.98	1.69	1.67	1.61	2.14	1.65	1.58
NP	t CaCO$_3$/1000 t	151	82	54	140	126	85	84	16	86	86
AP	t CaCO$_3$/1000 t	58.8	20.9	61.9	40.6	47.5	19.1	33.4	6.88	50.6	60.6
Net NP	t CaCO$_3$/1000 t	92.2	61.1	-7.88	99.4	78.5	65.9	50.6	9.12	35.4	25.4
NP/AP	ratio	2.57	3.92	0.87	3.45	2.65	4.46	2.51	2.33	1.70	1.42
S	%	2.23	0.857	2.22	1.62	1.91	0.786	1.35	0.287	1.91	2.21
Acid Leachable SO$_4$-S	%	0.35	0.19	0.24	0.32	0.39	0.18	0.28	0.07	0.29	0.27
Sulphide	%	1.88	0.67	1.98	1.30	1.52	0.61	1.07	0.22	1.62	1.94
C	%	1.84	0.880	0.415	1.60	1.28	0.905	0.843	0.206	0.877	0.882
CO$_3$	%	8.68	4.10	1.86	7.55	5.86	3.75	3.65	0.734	3.68	3.81
CO$_3$ NP	t CaCO$_3$/1000 t	144.1	68.1	30.9	125.3	97.3	62.3	60.6	12.2	61.1	63.2
CO$_3$ Net NP	t CaCO$_3$/1000 t	85.3	47.2	-31.0	84.7	49.8	43.2	27.2	5.3	10.5	2.6
CO$_3$ NP/AP	ratio	2.45	3.26	0.50	3.09	2.05	3.26	1.81	1.77	1.21	1.04
NP attributed to CO$_3$	%	95.4	83.0	57.2	89.5	77.2	73.2	72.1	76.2	71.0	73.5

Net Acid Generation

Parameter	Unit	CN 34 Residue	CN 35 Residue	CN 36 Residue	CN 37 Residue	CN 38 Residue	CN 39 Residue	CN 40 Residue	CN 41 Residue	CN 42 Residue	CN 43 Residue
Description		MCL-OG	MCL-OG	MCL-OG	MCL-OG	MCL-OG	MCL-OG	MCL-OG	MCL-OG	MCL-OG	MCL-OG
LIMS		13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15
Sample weight	g	1.50	1.51	1.53	1.48	1.49	1.47	1.47	1.48	1.51	1.47
Vol H$_2$O$_2$	mL	150	150	150	150	150	150	150	150	150	150
Final pH	unit	9.56	10.10	3.13	9.91	9.07	9.71	10.00	9.32	9.17	9.44
NaOH	Normality	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Vol NaOH to pH 4.5	mL	0.00	0.00	2.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Vol NaOH to pH 7.0	mL	0.00	0.00	4.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NAG (pH 4.5)	kg H$_2$SO$_4$/tonne	0	0	7.4	0	0	0	0	0	0	0
NAG (pH 7.0)	kg H$_2$SO$_4$/tonne	0	0	13	0	0	0	0	0	0	0
SO$_4$	mg/L	---	---	---	---	---	---	---	---	---	---

SO_4	%	---	---	---	---	---	---	---	---	---	---

Table IAAC-96-1 Modified Sobek ABA with Siderite Correction

Parameter	Unit	CN 44 Residue	CN 45 Residue	CN 46 Residue	CN 47 Residue	CN 48 Residue	CN 49 Residue	CN 50 Residue	CN 51 Residue	CN 52 Residue	CN 53 Residue
Description		MCL-OG	MCL-LG	MCL-LG	MCL-LG	MCL-LG	MCL-LG	MCL-LG	MCL-LG	MCL-LG	FL-OG
LIMS		13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15
Paste pH	unit	8.44	8.69	8.60	8.86	8.88	8.68	8.56	8.74	8.65	8.29
Fizz Rate	---	4	4	3	4	4	4	4	3	4	3
Sample weight	g	1.92	1.85	1.91	1.8	1.87	2.16	2.04	1.87	1.85	1.82
HCl_add	mL	74.30	53.00	60.70	58.90	58.20	88.50	87.80	20.00	55.00	40.50
HCl	Normality	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
NaOH	Normality	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Vol NaOH	mL to pH=8.3	21.45	18.70	17.88	18.00	18.32	23.63	30.09	4.71	20.64	22.20
Final pH	unit	1.88	1.77	1.94	1.86	1.97	1.75	1.59	2.10	2.01	1.89
NP	t $CaCO_3$/1000 t	125	81	101	102	95	138	124	30	80	36
AP	t $CaCO_3$/1000 t	34.4	24.7	45.0	20.6	28.4	31.2	50.6	27.5	25.0	60.0
Net NP	t $CaCO_3$/1000 t	90.6	56.3	56.0	81.4	66.6	107	73.4	2.50	55.0	-24.00
NP/AP	ratio	3.64	3.28	2.24	4.95	3.34	4.42	2.45	1.09	3.20	0.60
S	%	1.25	0.900	1.77	0.876	1.01	1.20	1.76	1.02	1.03	1.89
Acid Leachable SO_4-S	%	0.15	0.11	0.33	0.22	0.10	0.20	0.14	0.14	0.23	< 0.01
Sulphide	%	1.10	0.79	1.44	0.66	0.91	1.00	1.62	0.88	0.80	1.92
C	%	0.751	0.934	1.00	1.04	1.06	1.74	1.35	0.145	0.768	0.431
CO_3	%	3.09	3.93	4.30	4.73	4.52	7.51	5.38	0.515	3.45	0.994
CO_3 NP	t $CaCO_3$/1000 t	51.3	65.2	71.4	78.5	75.0	124.7	89.3	8.5	57.3	16.5
CO_3 Net NP	t $CaCO_3$/1000 t	16.9	40.5	26.4	57.9	46.6	93.5	38.7	-19.0	32.3	-43.5
CO_3 NP/AP	ratio	1.49	2.64	1.59	3.81	2.64	4.00	1.76	0.31	2.29	0.28
NP attributed to CO_3	%	41.0	80.5	70.7	77.0	79.0	90.3	72.0	28.5	71.6	45.8

Net Acid Generation

Parameter	Unit	CN 44 Residue	CN 45 Residue	CN 46 Residue	CN 47 Residue	CN 48 Residue	CN 49 Residue	CN 50 Residue	CN 51 Residue	CN 52 Residue	CN 53 Residue
Description		MCL-OG	MCL-LG	MCL-LG	MCL-LG	MCL-LG	MCL-LG	MCL-LG	MCL-LG	MCL-LG	FL-OG
LIMS		13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15
Sample weight	g	1.47	1.48	1.54	1.52	1.53	1.52	1.49	1.46	1.54	1.54
Vol H_2O_2	mL	150	150	150	150	150	150	150	150	150	150
Final pH	unit	9.66	9.53	9.67	9.69	10.02	9.75	9.62	3.20	9.86	8.77
NaOH	Normality	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Vol NaOH to pH 4.5	mL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.65	0.00	0.00
Vol NaOH to pH 7.0	mL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.95	0.00	0.00
NAG (pH 4.5)	kg H_2SO_4/tonne	0	0	0	0	0	0	0	5.5	0	0
NAG (pH 7.0)	kg H_2SO_4/tonne	0	0	0	0	0	0	0	9.9	0	0
SO_4	mg/L	---	---	---	---	---	---	---	---	---	---

SO_4	%	---	---	---	---	---	---	---	---	---	---

Table IAAC-96-1 Modified Sobek ABA with Siderite Correction

Parameter	Unit	CN 54 Residue	CN 55 Residue	CN 56 Residue	CN 57 Residue	CN 58 Residue	CN 59 Residue	CN 60 Residue	CN 61 Residue	CN 62 Residue	CN 63 Residue
Description		FL-OG	FL-OG	FL-OG	FL-OG	FL-OG	FL-OG	FL-OG	FL-OG	FL-OG	FL-OG
LIMS		13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15
Paste pH	unit	8.44	8.82	9.03	8.44	7.37	8.37	8.41	8.20	8.95	7.92
Fizz Rate	---	3	4	3	3	3	3	3	3	3	3
Sample weight	g	1.88	1.91	2	2.01	2.04	1.9	2.12	1.92	1.93	1.93
HCl_add	mL	39.00	57.20	20.00	40.00	31.00	30.00	29.90	65.00	20.00	40.20
HCl	Normality	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
NaOH	Normality	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Vol NaOH	mL to pH=8.3	19.29	15.64	3.52	19.69	5.86	7.90	8.55	15.95	7.82	15.70
Final pH	unit	1.82	1.83	2.70	1.82	2.30	2.26	2.23	1.83	2.15	1.95
NP	t $CaCO_3$/1000 t	8.0	99	34	39	49	40	33	118	14	54
AP	t $CaCO_3$/1000 t	99.4	25.3	20.3	83.1	129	63.1	50.3	82.2	27.8	87.8
Net NP	t $CaCO_3$/1000 t	-91.38	73.7	13.7	-44.12	-80.06	-23.12	-17.31	35.8	-13.81	-33.81
NP/AP	ratio	0.08	3.91	1.67	0.47	0.38	0.63	0.66	1.44	0.50	0.61
S	%	3.23	0.992	0.874	2.69	4.20	1.98	1.59	2.87	1.07	2.70
Acid Leachable SO_4-S	%	0.05	0.18	0.22	0.03	0.06	< 0.01	< 0.01	0.24	0.18	< 0.01
Sulphide	%	3.18	0.81	0.65	2.66	4.13	2.02	1.61	2.63	0.89	2.81
C	%	0.370	1.19	0.378	0.321	0.861	0.557	0.340	1.36	0.117	0.638
CO_3	%	0.894	4.78	1.38	1.06	2.10	1.76	1.07	5.88	0.425	2.17
CO_3 NP	t $CaCO_3$/1000 t	14.8	79.3	22.9	17.6	34.9	29.2	17.8	97.6	7.1	36.0
CO_3 Net NP	t $CaCO_3$/1000 t	-84.6	54.0	2.6	-65.5	-94.1	-33.9	-32.5	15.4	-20.7	-51.8
CO_3 NP/AP	ratio	0.15	3.14	1.13	0.21	0.27	0.46	0.35	1.19	0.25	0.41
NP attributed to CO_3	%	185.5	80.1	67.4	45.1	71.1	73.0	53.8	82.7	50.4	66.7

Net Acid Generation

Parameter	Unit	CN 54 Residue	CN 55 Residue	CN 56 Residue	CN 57 Residue	CN 58 Residue	CN 59 Residue	CN 60 Residue	CN 61 Residue	CN 62 Residue	CN 63 Residue
Description		FL-OG	FL-OG	FL-OG	FL-OG	FL-OG	FL-OG	FL-OG	FL-OG	FL-OG	FL-OG
LIMS		13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15
Sample weight	g	1.48	1.55	1.48	1.54	1.52	1.53	1.49	1.52	1.46	1.50
Vol H_2O_2	mL	150	150	150	150	150	150	150	150	150	150
Final pH	unit	2.48	9.69	9.10	9.22	3.23	8.84	8.64	9.97	2.69	2.87
NaOH	Normality	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Vol NaOH to pH 4.5	mL	12.05	0.00	0.00	0.00	1.95	0.00	0.00	0.00	5.37	4.02
Vol NaOH to pH 7.0	mL	17.25	0.00	0.00	0.00	7.66	0.00	0.00	0.00	7.21	6.18
NAG (pH 4.5)	kg H_2SO_4/tonne	40	0	0	0	6.3	0	0	0	18	13
NAG (pH 7.0)	kg H_2SO_4/tonne	57	0	0	0	25	0	0	0	24	20
SO_4	mg/L	---	---	---	---	---	---	---	---	---	---

SO_4	%	---	---	---	---	---	---	---	---	---	---

Table IAAC-96-1 Modified Sobek ABA with Siderite Correction

CN 65+66 results confirmed by reassay (ABA + NAG)

									MacLellan - Compo		
Parameter	**Unit**	**CN 64 Residue**	**CN 65 Residue**	**CN 66 Residue**	**CN 67 Residue**	**CN 68 Residue**	**CN 69 Residue**	**CND 2P**	**ML WR S>1%**	**ML WR AVG**	**ML ORE**
Description		FL-OG	FL-OG	FL-LG	FL-LG	FL-LG	FL-LG	Global			
LIMS		13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15	13463-JUL15	14293-AUG15			
Paste pH	unit	8.15	8.23	9.11	8.19	8.77	8.89	8.81			
Fizz Rate	---	3	3	3	4	3	3	4			
Sample weight	g	1.99	1.84	1.86	1.96	1.82	1.88	1.93			
HCl_add	mL	41.80	42.50	20.00	40.00	32.00	29.00	77.60			
HCl	Normality	0.10	0.10	0.10	0.10	0.10	0.10	0.10			
NaOH	Normality	0.10	0.10	0.10	0.10	0.10	0.10	0.10			
Vol NaOH	mL to pH=8.3	24.38	18.40	7.02	16.55	6.37	11.71	39.91			
Final pH	unit	1.88	1.90	2.28	1.82	2.40	2.20	1.73			
NP	t $CaCO_3$/1000 t	30	54	19	50	55	19	74			
AP	t $CaCO_3$/1000 t	102	95.0	7.19	58.1	19.7	8.44	55.3			
Net NP	t $CaCO_3$/1000 t	-72.50	-41.00	11.8	-8.12	35.3	10.6	18.7			
NP/AP	ratio	0.29	0.57	2.64	0.86	2.79	2.25	1.34			
S	%	3.30	3.08	0.313	1.93	0.778	0.306	1.72			
Acid Leachable SO_4-S	%	0.02	0.04	0.08	0.07	0.15	0.04	< 0.01			
Sulphide	%	3.28	3.04	0.23	1.86	0.63	0.27	1.77			
C	%	0.242	0.575	0.835	0.407	0.728	0.242	0.835			
CO_3	%	0.615	1.59	1.93	1.43	3.07	0.874	2.18			
CO_3 NP	t $CaCO_3$/1000 t	10.2	26.4	32.0	23.7	51.0	14.5	36.2			
CO_3 Net NP	t $CaCO_3$/1000 t	-91.8	-68.6	24.8	-34.4	31.3	6.1	-19.1			
CO_3 NP/AP	ratio	0.10	0.28	4.46	0.41	2.59	1.72	0.65	1.19	1.76	1.11
NP attributed to CO_3	%	34.0	48.9	168.6	47.5	92.7	76.4	48.9			

Net Acid Generation

Parameter	**Unit**	**CN 64 Residue**	**CN 65 Residue**	**CN 66 Residue**	**CN 67 Residue**	**CN 68 Residue**	**CN 69 Residue**	**CND 2P**			
Description		FL-OG	FL-OG	FL-LG	FL-LG	FL-LG	FL-LG	Global			
LIMS		13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15	13466-JUL15	14294-AUG15			
Sample weight	g	1.48	1.53	1.52	1.53	1.51	1.53	1.53			
Vol H_2O_2	mL	150	150	150	150	150	150	150			
Final pH	unit	2.79	8.51	4.00	2.82	10.02	9.50	8.11	9.3	9.5	9.3
NaOH	Normality	0.10	0.10	0.10	0.10	0.10	0.10	0.10			
Vol NaOH to pH 4.5	mL	5.58	0.00	0.23	4.01	0.00	0.00	0.00			
Vol NaOH to pH 7.0	mL	10.64	0.00	0.72	5.35	0.00	0.00	0.00			
NAG (pH 4.5)	kg H_2SO_4/tonne	18	0	0.7	13	0	0	0			
NAG (pH 7.0)	kg H_2SO_4/tonne	35	0	2.3	17	0	0	0			
SO_4	mg/L	---	---	---	---	---	---	190			

SO_4	%	---	---	---	---	---	---	< 0.1

Table IAAC-96-1 Modified Sobek ABA with Siderite Correction

		site		Gordon - Composite								
Parameter	**Unit**	**CND 3P**	**CND 5**	**FL I1 and I2**	**FL I3A**	**FL I3C**	**FL S2C**	**FL S3A**	**FL S5FI**	**FL S5J**	**FL ORE**	**CND 4P**
Description		MCL-OG	MCL-LG									FL-OG
LIMS		14293-AUG15	14293-AUG15									14293-AUG15
Paste pH	unit	8.87	9.08									8.65
Fizz Rate	---	4	3									3
Sample weight	g	2.00	2.00									2.08
HCl_add	mL	84.00	92.10									61.30
HCl	Normality	0.10	0.10									0.10
NaOH	Normality	0.10	0.10									0.10
Vol NaOH	mL to pH=8.3	38.37	42.29									35.50
Final pH	unit	1.72	1.66									1.69
NP	t $CaCO_3$/1000 t	92	100									42
AP	t $CaCO_3$/1000 t	53.4	40									69.4
Net NP	t $CaCO_3$/1000 t	38.6	60									-27.4
NP/AP	ratio	1.72	2.5									0.61
S	%	1.7	1.25									2.12
Acid Leachable SO_4-S	%	< 0.01	< 0.01									< 0.01
Sulphide	%	1.71	1.28									2.22
C	%	1.04	1.09									0.535
CO_3	%	3.14	3.75									1.02
CO_3 NP	t $CaCO_3$/1000 t	52.1	62.3									16.9
CO_3 Net NP	t $CaCO_3$/1000 t	-1.3	22.3									-52.5
CO_3 NP/AP	ratio	0.98	1.56	6.97	20.00	27.80	1.05	4.93	4.99	2.84	0.23	0.24
NP attributed to CO_3	%	56.7	62.3									40.3

Net Acid Generation

Parameter	**Unit**	**CND 3P**	**CND 5**									**CND 4P**
Description		MCL-OG	MCL-LG									FL-OG
LIMS		14294-AUG15	14294-AUG15									14294-AUG15
Sample weight	g	1.46	1.47									1.47
Vol H_2O_2	mL	150	150									150
Final pH	unit	8.09	8.34	9.5	9.4	9.4	9.4	10.5	9.8	10	9	7.55
NaOH	Normality	0.10	0.10									0.10
Vol NaOH to pH 4.5	mL	0.00	0.00									0.00
Vol NaOH to pH 7.0	mL	0.00	0.00									0.00
NAG (pH 4.5)	kg H_2SO_4/tonne	0	0									0
NAG (pH 7.0)	kg H_2SO_4/tonne	0	0									0
SO_4	mg/L	200	180									210

SO_4	%	< 0.1	< 0.1									< 0.1

Table IAAC-96-1 Modified Sobek ABA with Siderite Correction

Parameter	Unit	CND 6	CND 7
Description		FL-LG	Global
LIMS		14293-AUG15	14293-AUG15
Paste pH	unit	8.99	9.07
Fizz Rate	---	4	4
Sample weight	g	2.18	2.03
HCl_add	mL	52.80	81.00
HCl	Normality	0.10	0.10
NaOH	Normality	0.10	0.10
Vol NaOH	mL to pH=8.3	26.02	41.89
Final pH	unit	1.87	1.72
NP	t $CaCO_3$/1000 t	48	73
AP	t $CaCO_3$/1000 t	20.3	60.0
Net NP	t $CaCO_3$/1000 t	27.7	13.0
NP/AP	ratio	2.36	1.22
S	%	0.676	1.96
Acid Leachable SO_4-S	%	0.03	0.04
Sulphide	%	0.65	1.92
C	%	0.643	0.815
CO_3	%	1.74	2.11
CO_3 NP	t $CaCO_3$/1000 t	28.9	35.0
CO_3 Net NP	t $CaCO_3$/1000 t	8.6	-25.0
CO_3 NP/AP	ratio	1.42	0.58
NP attributed to CO_3	%	60.2	48.0

Net Acid Generation

Parameter	Unit	CND 6	CND 7
Description		FL-LG	Global
LIMS		14294-AUG15	14294-AUG15
Sample weight	g	1.53	1.54
Vol H_2O_2	mL	150	150
Final pH	unit	9.29	7.80
NaOH	Normality	0.10	0.10
Vol NaOH to pH 4.5	mL	0.00	0.00
Vol NaOH to pH 7.0	mL	0.00	0.00
NAG (pH 4.5)	kg H_2SO_4/tonne	0	0
NAG (pH 7.0)	kg H_2SO_4/tonne	0	0
SO_4	mg/L	74	220

SO_4	%	< 0.1	< 0.1

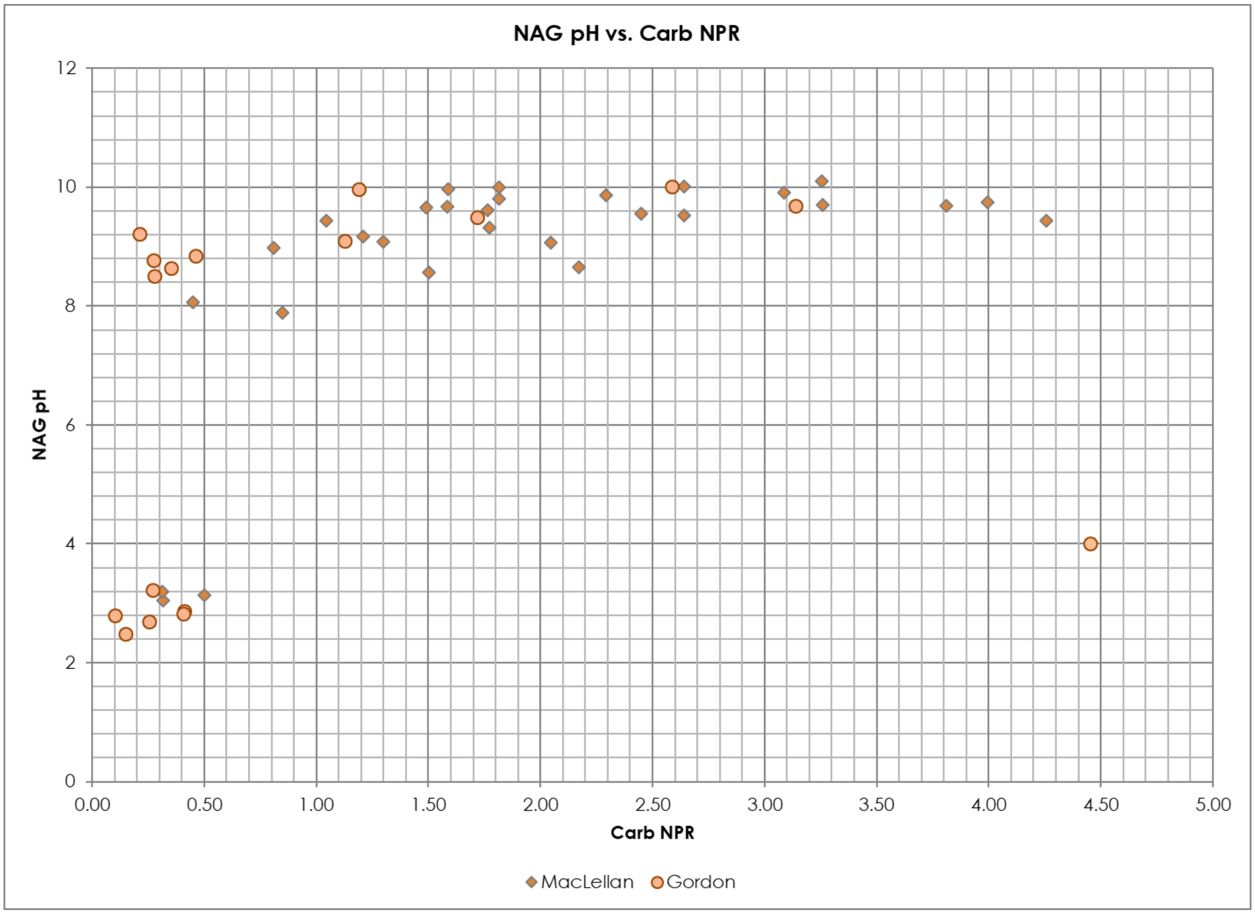


Figure IAAC-96-1 Net Acid Generating pH vs Net Potential Ratio

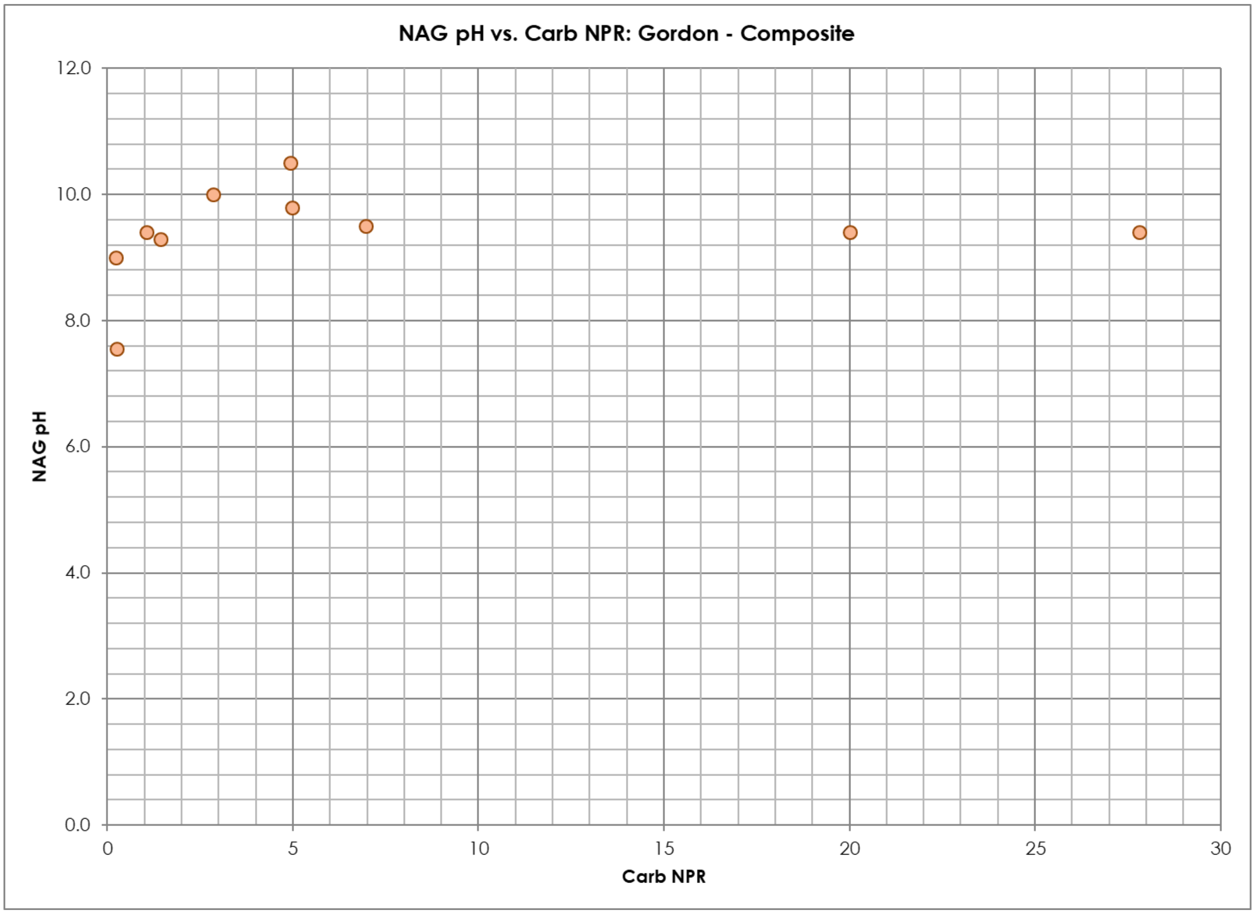


Figure IAAC-96-2 Net Acid Generating pH vs Net Potential Ratio – Gordon Site

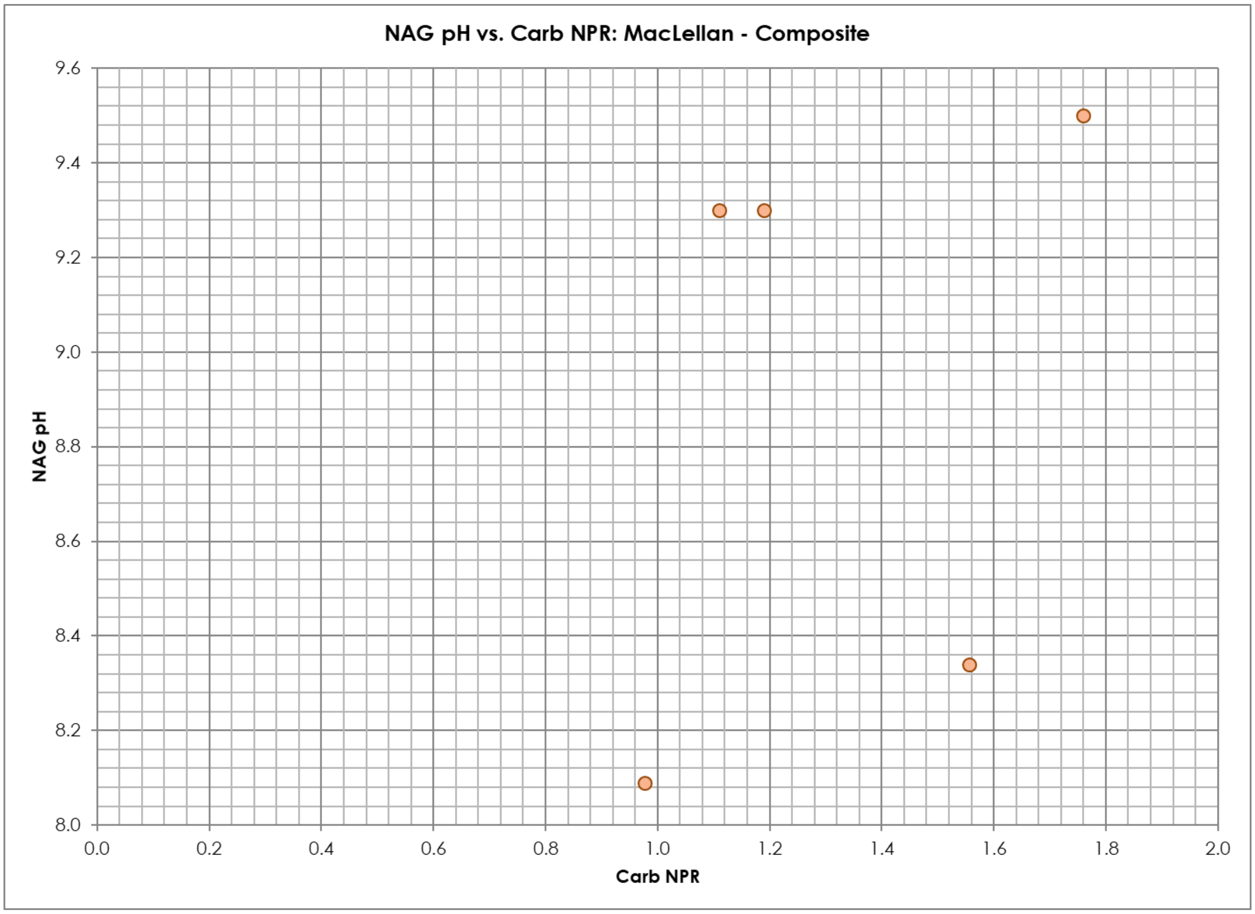


Figure IAAC-96-3 Net Acid Generating pH vs Net Potential Ratio – MacLellan Site

A.16 ATTACHMENT IAAC-98

Table IAAC-98-1: ML/ARD Potential of Historic and Future Waste Rock

Material	Sample ID	FIZZ RATING	NP (Lab)	Carb NP	AP	NNP	NPR	S_{TOTAL}	pH	$S_{SULPHIDE}$
		Unity	$tCaCO_3/1Kt$				Unity	%	Unity	%
MacLellan Site										
Historic MacLellan Rock	SA1 3M STPM-16-01	3	121	87	36	51	2.4	1.15	8.00	1.11
	SA1 1.5M STPM-16-02	3	136	96	42	54	2.3	1.35	7.90	1.22
	SA1 1.1M STPM-16-03	2	73	63	43	20	1.5	1.37	8.00	1.34
	SA2 2.6M STPM-16-03	1	18	11	1.9	9.4	6	0.06	7.80	0.05
	SA2 4.8M STPM-16-02	3	111	83	30	53	2.7	0.97	8.10	0.83
	SA1 1.1M STPM-16-04	3	117	83	36	47	2.3	1.15	7.90	0.87
	SA1 1.5M STPM-16-05	3	117	79	33	46	2.4	1.05	8.10	0.96
	SA2 3.9M STPM-16-04	3	106	69	36	34	1.9	1.14	8.00	0.90
	SA2 5M STPM-16-05	3	134	98	42	56	2.3	1.33	8.10	1.12
	Average	-	104	74	33	41	3.1	1.06	7.99	0.93
	St. Dev.	-	35	25	12	16	1.2	0.38	0.10	0.35
Future MacLellan Rock (total 160 samples)	Average	-	68	70	29	39	2.3	0.94	8.80	-
	St. Dev.	-	110	110	37	116	5	1.2	0.39	-
t test, two-tailed P		-	-	0.91	0.75	-	0.63	0.77	-	-
Gordon Site										
Historic Gordon Rock	SA1 1M STPF-16-01	2	48	35	2.8	32	12	0.09	7.60	0.07
	SA1 2M STPF-16-03	2	67	61	15	46	4	0.48	8.00	0.46
	SA1 3M STPF-16-02	2	60	53	8	45	7	0.25	7.90	0.24
	SA1 3M STPF-16-05	2	62	53	11	42	5	0.35	7.80	0.33
	SA1 3M STPF-16-06	2	54	53	15	39	4	0.47	7.90	0.45
	SA1 3M STPF-16-07	2	55	64	29	35	2.2	0.93	7.80	0.91
	SA1 3M STPF-16-08	2	72	69	8.4	60	8	0.27	7.80	0.24
	SA1 3.5M STPF-16-09	2	60	48	5.0	43	10	0.16	7.80	0.15
	SA1 0.5M STPF-16-11	2	39	26	4.1	22	6	0.13	7.60	0.09
	Average	-	57	51	11	40	5	0.35	7.80	0.33
	St. Dev.	-	9.3	13	7.6	10	3.0	0.24	0.12	0.25
Future Gordon Rock (total 142 samples)	Average	-	35	36	8.0	27	5	0.25	8.93	-
	St. Dev.	-	23	23	2.2	24	3.2	0.07	0.05	-
t test, two-tailed P		-	-	0.06	0.002	-	1.0	0.0012	-	-

Note: For Pt, Re, and Ta half detection limits (DLs) are used for the values reported as less than the DLs to calculate the average and standard deviation. t test results statistically not significant are highlighted green. P - probability.

Table IAAC-98-1: ML/AITable IAAC-98-1: ML/ARD Potential of Historic and Future Waste Rock

Material	$S_{SULPHATE}$	C	CO2	pH	Au	Ag	Al	As	Ba	Be	Bi	Ca
	%	%	%	Unity	ppm	ppm	%	ppm	ppm	ppm	ppm	%
MacLellan Site												
Historic MacLellan Rock	0.04	1.08	4	7.90	1.92	7.04	3.02	1230	153	0.22	0.561	3.43
	0.13	1.19	4.3	7.90	0.455	4.83	4.43	559	127	0.41	0.537	4.40
	0.03	0.78	2.8	8.00	0.839	8.18	3.26	1450	178	0.27	0.637	2.76
	0.01	0.14	0.5	7.70	0.0102	0.278	0.49	35	42	0.10	0.040	0.63
	0.14	1.03	3.8	8.10	0.761	7.64	2.34	208	316	0.14	0.706	3.71
	0.28	1.03	3.8	7.90	1.165	3.36	2.69	1025	64	0.22	1.69	3.83
	0.09	0.98	3.6	8.10	0.103	2.31	2.79	197	119	0.17	0.197	3.08
	0.24	0.86	3.1	7.90	0.203	3.28	2.86	556	197	0.25	0.214	3.66
	0.21	1.21	4.4	8.00	0.291	6.47	2.68	311	184	0.18	0.406	3.80
	0.13	0.92	3.4	7.94	0.639	4.82	2.73	619	153	0.22	0.554	3.26
	0.09	0.31	1.1	0.12	0.58	2.5	0.97	474	76	0.085	0.45	1.0
Future MacLellan Rock	-	0.84	-	8.80	-	0.700	3.10	91	92	0.17	0.190	3.00
(total 160 samples)	-	1.3	-	0.39	-	0.96	1.6	440	100	0.21	0.38	2.3
t test, two-tailed P	-	-	-	-	-	-	-	0.0006	-	-	-	-
Gordon Site												
Historic Gordon Rock	0.02	0.43	1.6	7.60	0.0297	0.054	1.79	6.71	127	0.8	0.259	1.41
	0.02	0.75	2.7	8.00	0.939	0.249	2.69	22.4	180.5	1.04	3.33	1.79
	0.01	0.66	2.4	7.90	0.102	0.105	2.1	77.3	106.5	1.34	0.384	1.61
	0.02	0.66	2.4	7.80	0.344	0.193	1.8	71.5	97.1	1.51	0.723	1.54
	0.02	0.66	2.4	7.90	0.306	0.138	1.79	48.3	121	1.5	0.712	1.31
	0.02	0.79	2.9	7.70	0.494	0.174	1.77	181	110	1.4	2.69	1.28
	0.03	0.85	3.1	7.90	0.115	0.098	2.06	58.9	130.5	1.33	0.346	1.92
	0.01	0.6	2.2	7.90	0.0364	0.049	2.37	59.6	109	1.25	0.249	1.81
	0.04	0.32	1.2	7.60	0.202	0.092	1.68	13.5	130.5	1.01	0.225	0.98
	0.02	0.64	2.3	7.81	0.285	0.128	2.01	59.9	123.6	1.24	0.991	1.52
	0.009	0.16	0.57	0.14	0.273	0.063	0.32	49.0	23.0	0.23	1.10	0.28
Future Gordon Rock	-	0.44	-	8.93	-	0.06	2.43	53.6	180.0	0.58	0.153	1.53
(total 142 samples)	-	0.28	-	0.05	-	0.01	0.52	34.1	35.6	0.31	0.024	0.88
t test, two-tailed P	-	-	-	-	-	-	-	0.60	-	-	-	-

Note: For Pt, Re, and Ta half detection limits (DLs) are used for the values reported as less than the DLs to calculate the average and standard deviation. t test results statistically not significant are highlighted green. P - probability.

Table IAAC-98-1: ML/AITable IAAC-98-1: ML/ARD Potential of Historic and Future Waste Rock

Material	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In
	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm
MacLellan Site												
Historic MacLellan Rock	9.54	30.7	47.7	278	1.365	165	4.93	9.02	0.152	0.087	0.059	0.029
	10.15	28.4	57.2	248	5.5	125	5.50	12.35	0.184	0.066	0.044	0.032
	12.35	31.7	50.9	285	2.42	157	5.29	9.23	0.154	0.106	0.107	0.042
	0.541	27.1	4.84	26.8	0.546	10.5	1.01	2.07	0.06	0.015	0.005	0.008
	19.25	30.8	46.4	206	1.1	182.5	4.09	7.42	0.154	0.075	0.146	0.029
	4.20	18	42.2	189.5	1.48	157.5	4.00	6.64	0.108	0.058	0.043	0.027
	5.48	26.6	53.9	362	1.49	151.5	4.32	7.96	0.146	0.105	0.014	0.021
	5.77	39.4	40.9	151	2.48	128.5	4.68	8.9	0.154	0.134	0.058	0.036
	12.25	32.3	48.7	252	1.125	173.5	4.58	7.63	0.137	0.109	0.08	0.05
	8.84	29.4	43.6	222	1.95	139	4.27	7.91	0.139	0.084	0.062	0.030
	5.2	5.4	15	90	1.38	48.8	1.25	2.58	0.034	0.033	0.042	0.011
Future MacLellan Rock (total 160 samples)	1.10	-	42	220	-	140	4.70	-	-	-	0.005	-
	7.3	-	23	250	-	180	2.30	-	-	-	0.009	-
t test, two-tailed P	0.002	-	-	0.98	-	0.98	0.56	-	-	-	-	-
Gordon Site												
Historic Gordon Rock	0.083	66.1	10.65	40.3	4.27	23.8	4.16	7.14	0.165	0.432	0.009	0.026
	0.061	61.4	18.85	69.1	21.5	45.5	11.9	8.97	0.496	0.315	<0.004	0.027
	0.032	39.8	11.7	36	15.2	26.6	15.05	6.18	0.606	0.231	<0.004	0.022
	0.023	41.8	9.78	34.7	12.9	24.3	17.4	5.95	0.671	0.206	<0.004	0.02
	0.019	36.4	9.4	32.2	18	13.5	16.4	5.08	0.724	0.229	<0.004	0.018
	0.019	30.6	10.9	25.4	20.5	22.2	15.5	4.83	0.71	0.175	<0.004	0.016
	0.031	41.9	10.85	33	17.4	24.8	13.25	6.13	0.562	0.253	<0.004	0.027
	0.032	40.3	12.35	46.3	13.65	16.75	14.1	7.38	0.653	0.265	<0.004	0.021
	0.055	53.9	8.93	34.6	8.83	16.7	7.14	5.73	0.29	0.283	<0.004	0.019
	0.039	45.8	11.49	39.1	14.69	23.79	12.77	6.38	0.542	0.265	0.003	0.022
	0.021	11.2	2.79	11.9	5.23	8.75	4.16	1.21	0.183	0.071	0.002	0.004
Future Gordon Rock (total 142 samples)	0.032	-	14.13	77.3	-	30.7	8.77	-	-	-	0.0044	-
	0.014	-	6.01	40.3	-	14.0	4.41	-	-	-	0.00012	-
t test, two-tailed P	0.16	-	-	0.0053	-	0.15	0.009	-	-	-	-	-

Note: For Pt, Re, and Ta half detection limits (DLs) are used for the values reported as less than the DLs to calculate the average and standard deviation. t test results statistically not significant are highlighted green. P - probability.

Table IAAC-98-1: ML/AITable IAAC-98-1: ML/ARD Potential of Historic and Future Waste Rock

Material	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Pd
	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm
MacLellan Site												
Historic MacLellan Rock	0.58	11.85	18	2.75	1120	0.99	0.066	0.15	291	0.076	751	0.001
	1.19	10.8	18.8	2.89	1615	1.04	0.119	0.144	275	0.071	719	0.003
	0.77	12.45	18.6	2.69	1005	1.12	0.075	0.217	302	0.07	841	0.003
	0.14	11.55	5	0.27	159.5	0.23	0.037	0.998	20.8	0.046	30.6	0.001
	0.42	11.85	17.9	2.14	867	0.66	0.084	0.138	212	0.08	775	0.003
	0.65	7.17	12.9	1.93	1175	0.65	0.071	0.125	311	0.044	207	0.002
	0.51	10.4	12.7	2.73	793	1.17	0.054	0.115	359	0.063	256	0.006
	0.72	16.9	19.8	1.99	801	1.24	0.081	0.255	129.5	0.087	288	0.001
	0.5	13	18.4	2.71	1060	0.88	0.058	0.132	234	0.068	588	0.007
	0.61	11.77	15.8	2.233	955	0.89	0.072	0.253	237	0.067	495	0.003
	0.27	2.41	4.5	0.77	367	0.30	0.022	0.267	98.8	0.014	283	0.002
Future MacLellan Rock (total 160 samples)	0.68	-	16	2.3	790	0.68	-	-	250	-	29	-
	0.77	-	11	1.3	1100	0.94	-	-	290	-	120	-
t test, two-tailed P	-	-	-	-	-	-	-	-	0.89	-	-	-
Gordon Site												
Historic Gordon Rock	0.49	30.6	27	1.07	507	0.53	0.035	1.61	24.7	0.069	7.49	0.0030
	0.89	27.3	26.8	2.24	1430	0.74	0.02	0.104	39.3	0.147	4.65	0.0030
	0.66	17.95	19.4	1.56	1435	0.6	0.02	0.144	21.7	0.141	4.18	0.0010
	0.53	17.65	17.1	1.74	1830	0.69	0.02	0.132	18.7	0.194	4.1	0.0010
	0.83	16.45	14.1	1.26	1680	0.41	0.015	0.114	15.05	0.127	3.3	0.0010
	0.84	12.65	11.7	1.29	1800	0.31	0.012	0.075	13.85	0.12	3.5	0.0010
	0.74	18.85	22	1.75	1410	0.49	0.019	0.244	20	0.136	3.95	0.0010
	0.72	18	22.1	1.44	1050	0.56	0.024	0.173	21.7	0.139	2.57	0.0010
	0.67	24.9	20.6	0.97	820	0.46	0.025	1.01	17.8	0.073	5.35	<0.001
	0.71	20.48	20.1	1.48	1329	0.53	0.021	0.401	21.4	0.127	4.34	0.0014
	0.13	5.47	4.90	0.371	426	0.13	0.006	0.508	7.08	0.036	1.34	0.0009
Future Gordon Rock (total 142 samples)	0.88	-	18.3	1.44	617	1.70	-	-	39.3	-	2.83	-
	0.23	-	6.02	0.68	160	1.41	-	-	20.9	-	0.56	-
t test, two-tailed P	-	-	-	-	-	-	-	-	0.012	-	-	-

Note: For Pt, Re, and Ta half detection limits (DLs) are used for the values reported as less than the DLs to calculate the average and standard deviation. t test results statistically not significant are highlighted green. P - probability.

Table IAAC-98-1: ML/AITable IAAC-98-1: ML/ARD Potential of Historic and Future Waste Rock

Material	Pt	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th
	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
MacLellan Site												
Historic MacLellan Rock	0.002	18.85	0.002	1.16	3.98	8.81	0.5	0.36	105.5	<0.005	0.11	1.25
	<0.002	39.4	0.002	1.39	2.75	13.6	0.4	0.51	81.2	0.005	0.11	1.075
	<0.002	25.2	0.001	1.51	5.57	9.45	0.60	0.45	73.8	<0.005	0.15	1.385
	<0.002	8.42	<0.001	0.07	0.233	1.64	0.10	0.28	12.7	<0.005	0.01	4.04
	<0.002	16.6	0.001	1.04	4.06	8.26	0.40	0.25	76.5	<0.005	0.09	1.11
	<0.002	24.3	0.001	1.18	5.79	6.48	0.50	0.34	65	<0.005	0.15	1.03
	<0.002	17.25	0.003	1.03	1.1	7.24	0.50	0.26	78.7	<0.005	0.07	0.961
	0.002	23.1	0.001	1.2	1.99	9.3	0.50	0.57	69.6	0.005	0.06	1.705
	0.002	16.85	0.002	1.32	5.19	8.36	0.50	0.31	76.9	<0.005	0.12	1.1
	0.0013	21.11	0.002	1.10	3.41	8.13	0.44	0.37	71.1	0.003	0.10	1.52
	0.0005	8.06	0.001	0.39	1.89	2.97	0.13	0.11	23.2	0.001	0.04	0.92
Future MacLellan Rock	-	-	-	-	0.270	-	0.69	0.36	-	-	-	-
(total 160 samples)	-	-	-	-	0.300	-	0.73	0.51	-	-	-	-
t test, two-tailed P	-	-	-	-	-	-	0.31	-	-	-	-	-
Gordon Site												
Historic Gordon Rock	<0.002	40.1	<0.001	0.10	0.121	5.77	0.20	0.81	31.6	<0.005	0.07	10.55
	<0.002	35	0.001	0.51	0.315	10.35	0.30	0.45	48.8	<0.005	1.5	1.98
	<0.002	31	<0.001	0.27	0.412	6.22	0.30	0.37	50.1	<0.005	0.13	2.13
	<0.002	24.7	<0.001	0.36	0.401	5.13	0.30	0.33	38.4	<0.005	0.42	1.9
	<0.002	38.9	0.001	0.49	0.472	3.95	0.20	0.30	38.3	<0.005	0.19	1.52
	<0.002	35.4	<0.001	0.92	0.655	3.7	0.40	0.30	34.2	<0.005	1.00	0.517
	<0.002	37.4	0.001	0.27	0.331	5.61	0.20	0.46	35.0	<0.005	0.09	3.44
	<0.002	28.7	<0.001	0.16	0.611	7.38	0.30	0.44	50.6	<0.005	0.05	1.89
	<0.002	41.1	<0.001	0.14	0.188	4.32	0.20	0.59	23.5	<0.005	0.05	7.18
	0.001	34.7	0.0007	0.36	0.390	5.83	0.27	0.45	38.9	0.003	0.39	3.46
	0	5.22	0.0002	0.24	0.166	1.94	0.07	0.15	8.7	0	0.49	3.08
Future Gordon Rock	-	-	-	-	0.240	-	0.54	0.38	-	-	-	-
(total 142 samples)	-	-	-	-	0.092	-	0.08	0.09	-	-	-	-
t test, two-tailed P	-	-	-	-	-	-	0.0001	-	-	-	-	-

Note: For Pt, Re, and Ta half detection limits (DLs) are used for the values reported as less than the DLs to calculate the average and standard deviation. t test results statistically not significant are highlighted green. P - probability.

Table IAAC-98-1: ML/AITable IAAC-98-1: ML/ARD Potential of Historic and Future Waste Rock

Material	Ti	Tl	U	V	W	Y	Zn	Zr
	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm
MacLellan Site								
Historic MacLellan Rock	0.102	0.205	0.246	110	1.015	8.95	1220	3.22
	0.194	0.393	0.303	153	1.715	9.83	1415	2.59
	0.136	0.282	0.438	107	1.965	8.6	1595	4.19
	0.051	0.068	0.647	17.3	0.215	5.08	97.3	0.91
	0.114	0.214	0.197	102	0.908	9.93	2430	2.66
	0.087	0.209	0.288	68.9	4.14	5.84	638	2.01
	0.100	0.175	0.288	102	0.8	7.4	721	3.77
	0.135	0.258	0.454	97.4	0.546	12.65	803	5.37
	0.105	0.226	0.273	95.6	0.625	9.25	1590	3.98
	0.114	0.226	0.348	94.8	1.325	8.61	1168	3.19
	0.037	0.082	0.132	34.2	1.124	2.15	648	1.24
Future MacLellan Rock	0.150	0.170	0.260	110	-	7.4	110	-
(total 160 samples)	0.095	0.180	0.510	71	-	9.2	150	-
t test, two-tailed P	-	-	-	-	-	-	0.0001	-
Gordon Site								
Historic Gordon Rock	0.118	0.212	1.565	46.8	0.252	11.45	53.5	18.3
	0.126	0.151	0.969	92.4	0.682	12.3	54.2	11.3
	0.089	0.111	0.664	57.8	0.33	12.1	28.4	10.0
	0.076	0.165	0.723	51.8	0.389	14.05	23.4	8.71
	0.085	0.12	0.431	38.9	0.294	10.35	18.7	9.15
	0.075	0.147	0.327	35.6	0.200	9.50	17.8	7.67
	0.099	0.139	0.724	49.9	0.267	11.95	28.9	10.7
	0.092	0.088	0.572	60.7	0.198	11.30	32.2	11.1
	0.103	0.174	1.100	38.4	0.259	10.50	37.2	12.4
	0.096	0.145	0.786	52.5	0.319	11.50	32.70	11.0
	0.017	0.035	0.357	16.3	0.140	1.25	12.71	2.89
Future Gordon Rock	0.13	0.12	1.22	78.0	-	9.77	54.00	-
(total 142 samples)	0.04	0.05	0.86	25.0	-	1.11	28.47	-
t test, two-tailed P	-	-	-	-	-	-	0.028	-

Note: For Pt, Re, and Ta half detection limits (DLs) are used for the values reported as less than the DLs to calculate the average and standard deviation. t test results statistically not significant are highlighted green. P - probability.

A.17 ATTACHMENT IAAC-99

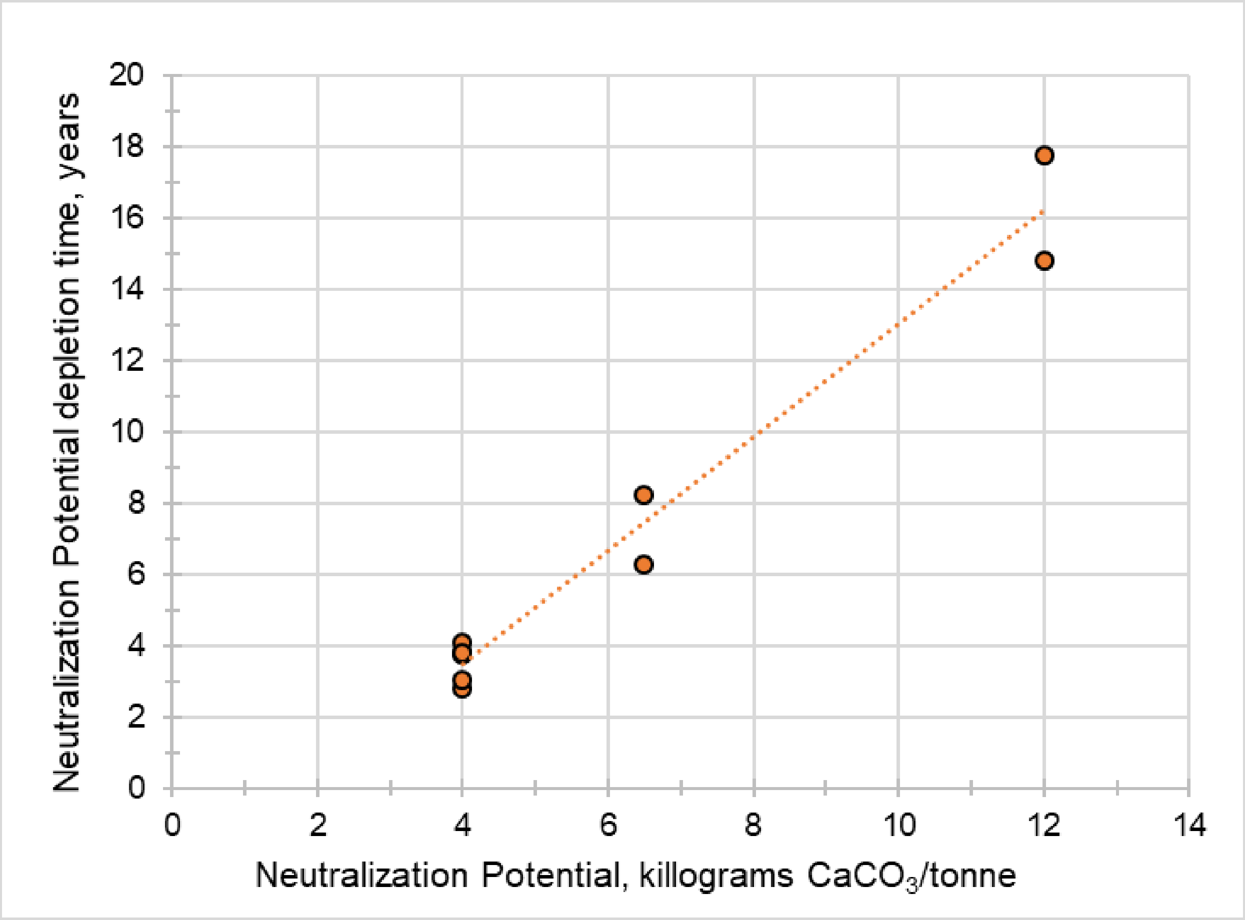


Figure IAAC-99-1 Neutralization Potential Depletion Time vs. Neutralization Potential in PAG samples of argillite

ATTACHMENT IAAC-99

Objective

The objective of this document is to provide rationale and basis for acid rock drainage (ARD) management of mine rock considering Project specifics: selection of ARD management options, sequencing, design and operational procedures.

Rationale for Selected Approach

The Global Acid Rock Drainage (GARD) guide presents best practices for management of mine rock:

1) Avoidance: decision to limit mining reactive materials
2) Remining: improvement for disposal of problematic waste during reactivation of historical mines
3) Special handling methods:
    a) Backfill during mine operations
    b) Segregation of potentially acid generating (PAG) rock with dry and wet covers
    c) Encapsulation and layering
    d) Blending
    e) Co-disposal of mine rock and tailings
    f) Freezing (permafrost development)

The summary of preliminary assessment of alternatives for these options is provided below:

Avoidance (1) is not applicable to the Project mainly because there was only one PAG unit, argillite, clearly identified during the assessment. Mining of this unit cannot be avoided because argillite dips sub vertically and extends to the middle of the Gordon pit as shown on cross sections attached to response IAAC-98. At the MacLellan site, there was no opportunity for avoidance due to the random distribution of PAG rock based on the ARD block model.

In consideration of remining (2), portions of the historical south mine rock storage area overprints within the proposed Gordon pit footprint and will be relocated to a new mine rock storage area, which is located farther from the primary environmental receptors. The historical mine rock shows low acid rock drainage/metal leaching (ARD/ML) potential based on monitoring and does not require special management.

Special handling methods (3), such as backfilling during mine operations (3a) and freezing (3f), are not applicable to the Project. Segregation (3b) of all PAG rock would require more space for PAG rock storage. In addition, subsequent rehandling, in the case of PAG rock submergence in pits or applying low permeability covers, would result in higher cost. Therefore, segregation is not the preferable option for mine rock management, but it is considered for the case of excess of PAG rock generated in the last year(s) of mining. Low permeability materials must be imported to the site, but soil cover was considered to be a good candidate to act as a barrier to advective flow and for use as growth media for reclamation.

A combination of encapsulation (3c) and blending (3d) have the following advantages: rock can be deposited by conventional and proven methods such as a pile/dump, no additional space is required, and minimal cost is added.

Co-disposal of mine rock and tailings (3e) has a benefit similar to blending, but results in an increase in the tailing management facility (TMF) footprint and poses challenges related to dam stability and water management.

As a result of the preliminary alternatives assessment, encapsulation (3c) and blending (3d) were selected as options for management of PAG rock and these are further evaluated in the following sections.

Geochemical Design Criteria for Rock Blending

ARD Criteria

As a first step, site-specific ARD criteria were developed based on alkalinity and acidity depletion rates calculated from field bins tests containing different mine rock lithologies shown in Attachment IAAC-99 Table 1 (copied from Volume 4, Appendix F, Table 4.4-1). The lower of a generic Net Potential Ratio (NPR) threshold of 2 or the highest ratio of Neutralization Potential (NP) depletion rate over Acid Potential (AP) depletion rate (NP rate/AP rate) was selected. The ARD threshold of 1.2 was selected for the MacLellan rock blend based on the highest ratio of NP rate to AP rate field bins tests. For the Gordon rock, a generic NPR threshold of 2 was selected because the highest ratio of NP rate to AP rate was 7.4, likely caused by low sulfur content combined with the low mass of the sample.

In summary, rock blends with NPR values above 1.2 and 2 were non-PAG for MacLellan and Gordon sites, respectively.

Rock Production and Destination

Annual production of ARD rock types (PAG, non-PAG [or n-pag], and uncertain) and characteristics of each rock type, such as AP and NP were obtained from the mine plan and ARD block models. These inputs allowed calculation of NPR values of blended rock on an annual basis for each mine site. Rock, which will be used for construction and encapsulation, was conservatively excluded from the calculation of NPR values of blended rock. Attachment IAAC-99 Figure 1 indicates that the annual NPR values of blended rock will stay above the respective ARD thresholds indicating that the blending option is feasible and effective during operation from an acid-base accounting perspective.

Table IAAC-99-1 Acid Base Accounting (ABA) for Samples Subjected to Kinetic Test

Site	Parameter	Paste pH	^{S}Total	TIC	AP	NP	NPR = NP/AP	NP rate/AP rate, HC last month average	NP rate/AP rate, FLB, all event average
	Sample ID (Material)	**pH Units**	**wt. %**	**wt. %**	**kgCACO$_3$/t**		**Ratio**		
Gordon	FL I1 and I2 (mine rock)	9.0	0.26	0.67	8	56	7	9	1.6
	FL I3A (mine rock)	8.9	0.15	1.1	4.6	92	20	18	--
	FL I3C (mine rock)	9.0	0.13	1.3	4.0	110	28	21	7.4
	FL S2C (mine rock)	9.1	0.36	0.14	11	12	1.05	1.9	1.8
	FL S3A (mine rock)	9.9	0.17	0.32	5.4	27	4.9	5.6	--
	FL S5FI (mine rock)	9.2	0.18	0.34	5.6	28	5	2.7	1.9
	FL S5J (mine rock)	9.5	0.26	0.28	8.2	23	2.8	2.5	2.2
	FL ORE (ore)	8.7	3.09	0.27	97	23	0.23	1.3	1.1
	CND 4P (tailings)	8.7	2.12	0.2	66	17	0.26	1.3	--
	CND 6 (tailings)	9.0	0.68	0.35	21	29	1.4	2.3	--
	CO3 DPL CND 4P (tailings)	6.6	2.2	0.02	69	1.6	0.02	0.9	--
MacLellan	ML WR S>1% (mine rock)	8.8	1.8	0.82	57	68	1.2	1.5	1.1
	ML WR AVG (mine rock)	8.9	1.00	0.66	31	55	1.8	2.0	1.2
	ML ORE (ore)	8.7	2.18	0.91	68	76	1.1	2.0	1.3
	CND 3P (tailings)	8.9	1.7	0.63	53	52	0.99	1.5	--
	CND 5 (tailings)	9.1	1.3	0.75	39	63	1.6	1.9	--
	CO3 DPL CND 3P (tailings)	8.7	2.0	0.03	62	2.4	0.04	1.1	--
MacLellan/Gordon Global Composite	CND 2P (tailings)	8.8	1.7	0.44	54	36	0.68	1.5	--
	CO3 DPL CND 2P (tailings)	8.1	2.0	0.04	63	3.3	0.05	1.0	--
Gordon/MacLellan	MAC-FAR COMP (tailings)	8.2	0.06	0.05	1.9	4.0	2.2	4.5	--

^{S}Total = Total Sulphur; TIC = Total Inorganic Carbon; NP = Neutralization Potential from Ca-Mg carbonates; AP = Acid Potential calculated from total Sulphur; NPR <2 are shaded
HC = Humidity cell; FLB = Field Bin

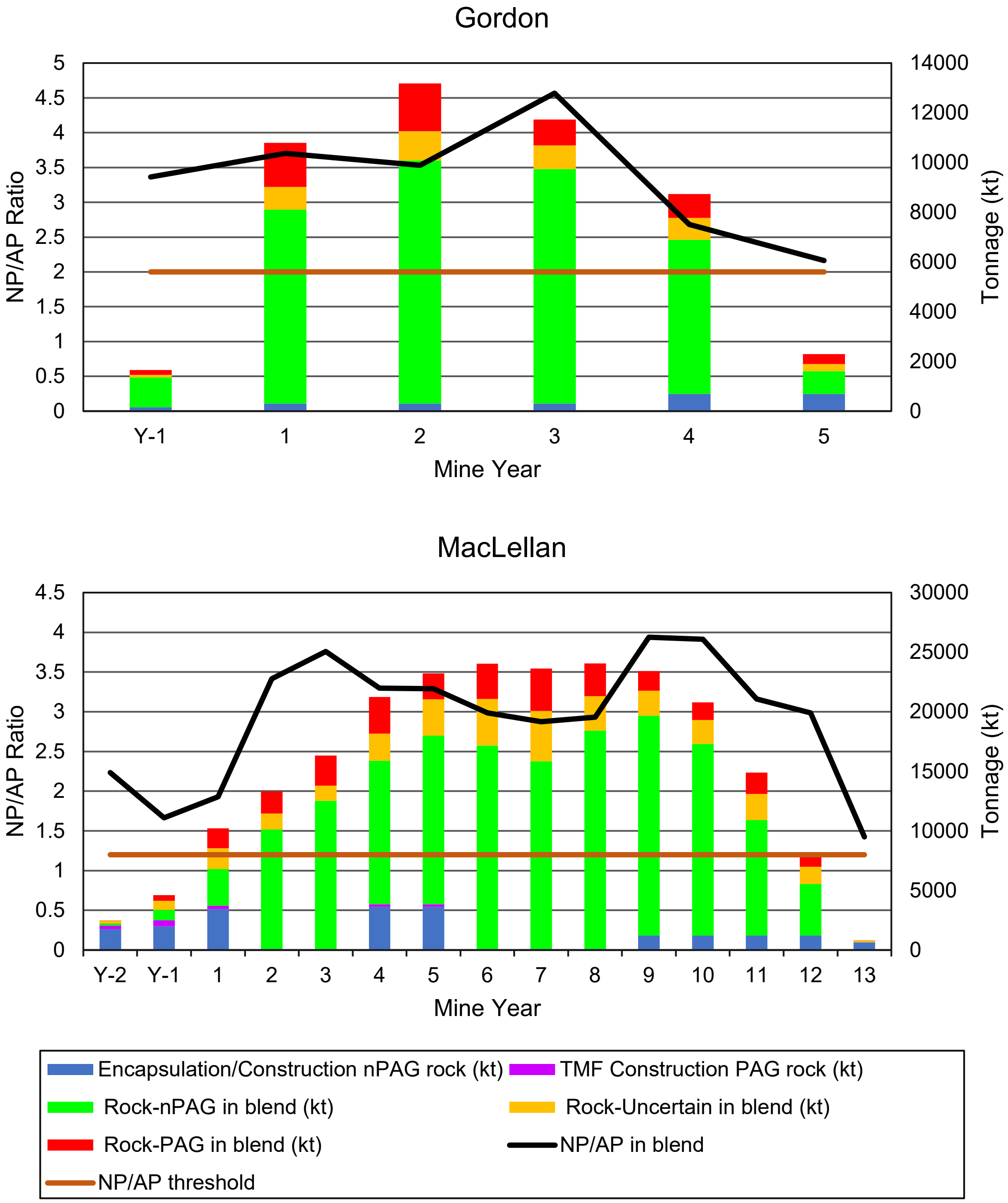


Figure 1 Annual Production of ARD Rock Types and NPR of Blend of Rock Prior Encapsulation

Blending at Operational Level

The objective of blending is to place PAG and non-PAG rock so that the PAG rock does not acidify, resulting in neutral drainage emanating from the mine rock storage area. The geochemical basis for blending is discussed by (Mehling et al. 1997) and considers the layering of PAG and non-PAG rock for a mine rock pile constructed using the end-dumping method (Attachment IAAC-99 Figure 2). The geochemical requirements for blending can be summarized as follows:

- Non-PAG rock layers will be placed above PAG deposition areas to provide alkalinity (dissolved NP) that will migrate into the PAG layer. The acid producing rate in the PAG areas is not to exceed the rate of alkalinity supply from layer above.
- The non-PAG rock layer is to have more net NP than the net AP of the PAG layer below.

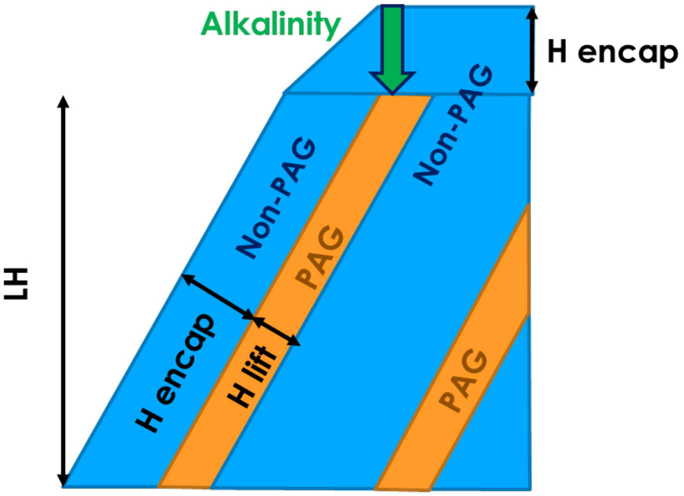


Figure 2 **Locations of PAG and Non-PAG Rock Layers in Schematic Cross Section of Two Upper Lifts in Mine Rock Piles (LH = Lift Height; H encap = Height of encapsulation layer)**

For the first requirement, the maximum thickness of PAG layer was estimated using Equation 1.

$$H_{PAG} = Alk \times Inf / (R_{SO4} \times Conv \times Wk \text{ x } \rho \times SF) \qquad \text{(Eq. 1)}$$

The numerator of this equation represents annual alkalinity supplied by infiltration from the non-PAG layer per square metre and the denominator is annual acidity production in the PAG layer per cubic metre. The inputs to the equation and references are listed in Attachment IAAC-99 Table 1. The resulting maximum thickness of the PAG rock layer (H_{PAG}) is 1.0 m and 2.5 m for Gordon and MacLellan, respectively. If the PAG layer is formed by end-dumping, the lift will have an adequate height for PAG layers to be below the indicated thickness (H_{PAG}). The lift height for end dumping deposition (LH_{min}) was calculated using Equation 2 assuming a CAT 789D truck.

$$LH_{min} = M_{LOAD}/ H_{PAG}/ \rho / W_{LOAD} \qquad \text{(Eq. 2)}$$

The resulting minimum lift height for end dumping should be above 7.1 m for the Gordon site and 3.5 m for the MacLellan site. These values are lower than the lift heights of 10 m and 15 m proposed for Gordon and MacLellan piles, respectively. The proposed heights are adequate to form PAG layers with a thickness below H_{PAG} by the end dumping method. For 10 m to 15 high lifts, one truck load would theoretically form uniform layers with a thickness from 0.6 m to 0.7 m.

The second requirement for blending, Net $NP_{non\text{-}PAG}$ > Net AP_{PAG}, is satisfied for average inputs for Net NP of non-PAG rock and average or 90th percentile inputs Net AP_{PAG} for both sites. These results indicate that an average layer of non-PAG rock will provide sufficient alkalinity to neutralize potential acidity generated from 90% of PAG rock layers. The satisfaction of two requirements supports feasibility of blending at the operational level considering the requirement that a load of non-PAG rock will always be deposited over a layer of PAG rock.

Encapsulation

Based on the first requirement for blending, PAG rock will be encapsulated with non-PAG rock meaning that no PAG rock will be exposed on bench faces and the tops of the mine rock storage areas (MRSAs) (Attachment IAAC-99 Figure 2). Non-PAG rock will reduce oxygen flux into the interior of the pile and will provide alkalinity to infiltrating water. The minimum encapsulating thickness (H_{encap}) was conservatively estimated using Equation 3 using inputs for an unlikely scenario defined by a condition of a PAG-layer containing 90th percentile Net AP that is covered with non-PAG contain only 10th percentile Net NP (Attachment IAAC-99 Table 2).

$$H_{encap} = H_{Lift} \times \text{Net } NP_{non\text{-}PAG} / \text{Net } AP_{PAG} \qquad \text{(Eq. 3)}$$

This conservative estimate indicates that the thickness of the final non-PAG shell should be at least 2.6 m at the Gordon site and 2 m at the MacLellan site (Attachment IAAC-99 Table 2).

Preliminary Operational Procedures

The most current ARD block models locate the probable PAG materials in the Gordon and MacLellan open pits. The model predictions will be verified by operational sampling and will then be managed using the following procedures, which are subject to further refinement:

- Samples of drill cuttings from blast holes representing each mine block will be collected.
- The samples will be tested for total carbon and sulphur using LECO furnace or similar method. Average NP will be calculated from total carbon and average AP will be calculated from total sulphur using standard conversions per the Mine Environment Neutral Drainage (MEND) guidelines. If NP/AP ratios indicate the mine block rock is below 2 at Gordon and below 1.2 at MacLellan, the block will be classified as PAG.
- PAG rock will be marked after the blast, excavated, and dispatched to the mine rock storage areas. PAG rock will be deposited, marked and the geospatial coordinates recorded.
- Non-PAG rock will be deposited over PAG rock to allow blending on the active lift face and to maintain the minimum thickness of PAG layers.

- This blend will be encapsulated with layers of non-PAG rock having a minimum encapsulating thickness (H_{encap}) of 2.6 m at the Gordon site and 2 m at the MacLellan site.

Conclusion

The results presented above support the assertion that ARD can be effectively managed at both sites by blending and encapsulation at the operational level. Additional details describing management of acid generating rock will be presented in the final ARD/ML Management Plan, which will occur during the permitting stage of Project planning (i.e., following receipt of a federal Decision Statement for the Project under *CEAA 2012* and provincial licences for the Project under *The Environment Act* of Manitoba) and will be completed prior to the start of Project construction.

References

Global Acid Rock Drainage Guide (GARD). http://www.gardguide.com/

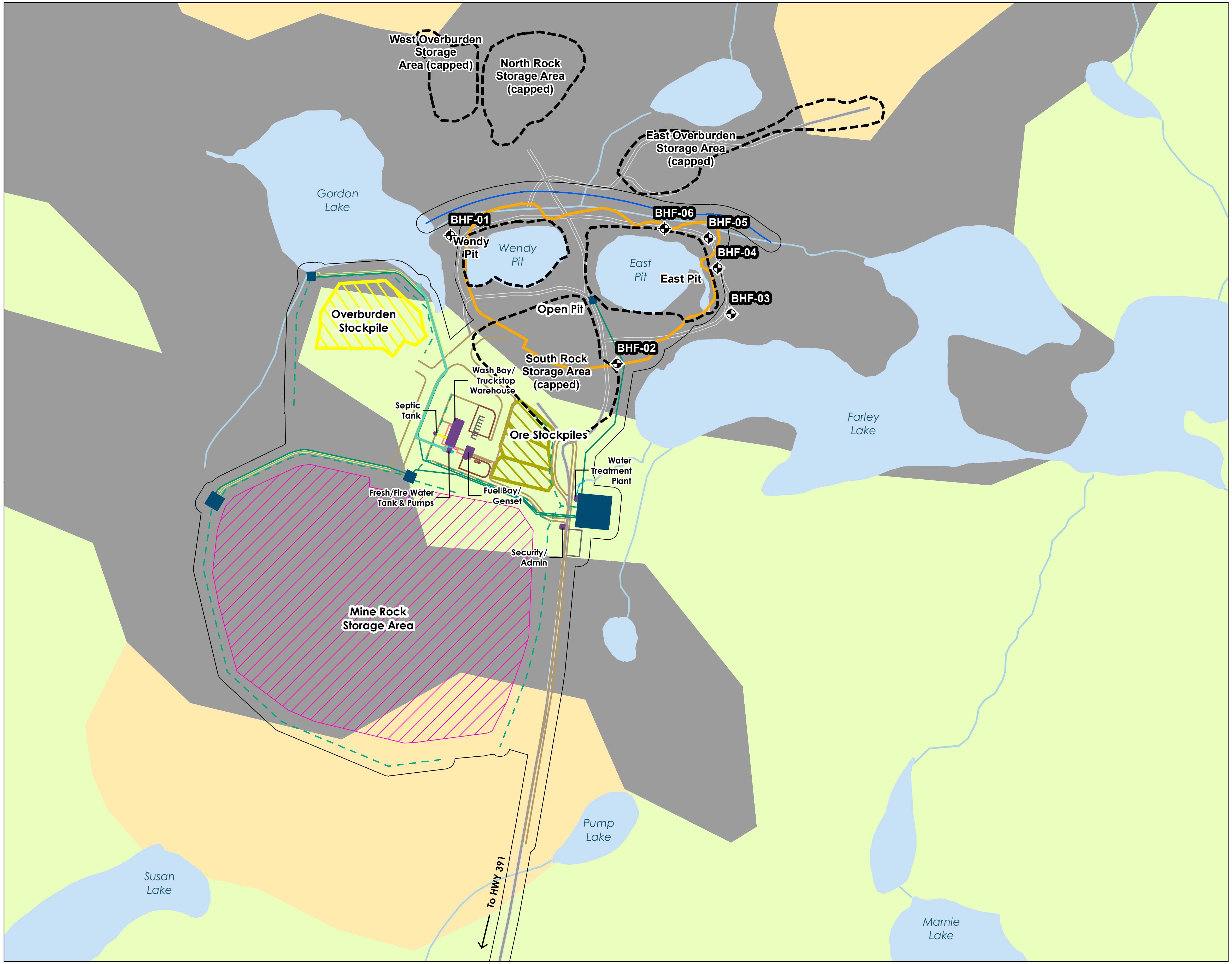
Mehling, P., S. Day and K. Sexsmith. 1997. Blending and Layering Mine rock to Delay Mitigate or Prevent Acid Generation: A Case Study Review. In: Proceedings of the Fourth International Conference on Acid Rock Drainage, Vancouver, B.C., May 31 to June 6, 1997.

Mine Environment Neutral Drainage Program (MEND). 2009. Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials, MEND Report 1.20.1, p. 1-579.

Table IAAC-99-2 Inputs and Results of the Calculations

Description	Symbol	Units	Gordon	MacLellan	Comments/Reference
Alkalinity in contact water	Alk	mg $CaCO_3$/L	220	140	Pits at depth and Shaft in Table 4.5-1 Appendix F, Volume 4 of the EIS.
Infiltration (50% of normal year)	Inf	L/m^2/yr	239	239	Appendix D (MacLellan) and E (Gordon) of the EIS
Sulfate leaching rate in PAG rock	R^{SO4}	SO_4 mg/kg/wk	6	6.8	Appendix D (MacLellan) and E (Gordon) of the EIS
Conversion SO_4 to Calcite equivalent	Conv	unitless	1.05	1.05	M $CaCO_3$/M SO_4 conversion
Week to year conversion	wk	wk/yr	52.2	52.2	conversion
Bulk (deposited density)	p	kg/m^3	2720	2310	Q'Pit personal communication
Scaling factor	SF	unitless	0.057	0.0153	Appendix D (MacLellan) and E (Gordon) of the EIS
Max thickness of PAG layer	H_{PAG}	m	1.0	2.5	Results
Minimum lift height for H PAG	LH_{min}	m	7.1	3.4	Results
Assumed Operation					
Average mass of in rock tuck	M_{LOAD}	kg	140,000	140,000	Qpit (Tim) personal communication
Rock truck bucket width	W_{LOAD}	m	7	7	Assuming CAT 789D tuck
Lift height	LH	m	10	15	Qpit (Tim) personal communication
Thickness of load on face	H_{Lift}	m	0.7	0.6	Results
Average PAG Net Acid Potential	Ave Net AP_{PAG}	kg $CaCO_3$/t	13	18	Calculated from all samples with NPR<2
90th percentile PAG Net Acid Potential	10th Net AP_{PAG}	kg $CaCO_3$/t	35	42	Calculated from all samples with NPR<2
Average non-PAG Net Neutralization Potential	Ave Net $NP_{non\text{-}PAG}$	kg $CaCO_3$/t	48	79	Calculated from all samples with NPR>2
10th percentile non-PAG Net Neutralization Potential	10th Net $NP_{non\text{-}PAG}$	kg $CaCO_3$/t	10	12	Calculated from all samples with NPR>2
Minimum encapsulation ratio	F_{encap}	unitless	3.6	3.5	Results
Minimum encapsulation thickness	H_{encap}	m	2.6	2.0	Results

A.18 ATTACHMENT IAAC-101



Stantec

Project Infrastructure

- Proposed Open Pit
- Potential Ore Stockpile
- Potential Mine Rock Storage Area
- Potential Overburden Stockpile
- Project Development Area
- Buildings
- Pond

Site Access

- Proposed Site Access Road
- Drainage Road

Other Infrastructure

- Construction Temporary Facility
- Parking
- Diversion Channel
- Fresh Water Pipe
- Sewer
- Potable Water
- Drainage Ditch - Clean water
- Drainage Ditch - Potentially Contaminated
- Drainage Pipe
- Fire Water

Overburden Sample Locations

- Borehole Location

Historical Mine Infrastructure

- Existing Infrastructure Associated with Historical Mine

Surficial Geology

- Organic Deposits
- Marginal Glaciolacustrine Sediments
- Sand Diamicton

Landbase

- Existing Access Road
- Watercourse
- Waterbody

N

0 250 500 Metres

(At original document size of 11x17)
1:12,000

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada.
3. Project Infrastructure features provided by QPit and Ausenco.

Project Location
Lynn Lake,
Manitoba

Prepared by ACampigotto on 2021-01-29
Technical Review by EKhozhina on 2021-01-29

Client/Project
111473008
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-101-1

Title
Project Development Area - Gordon site

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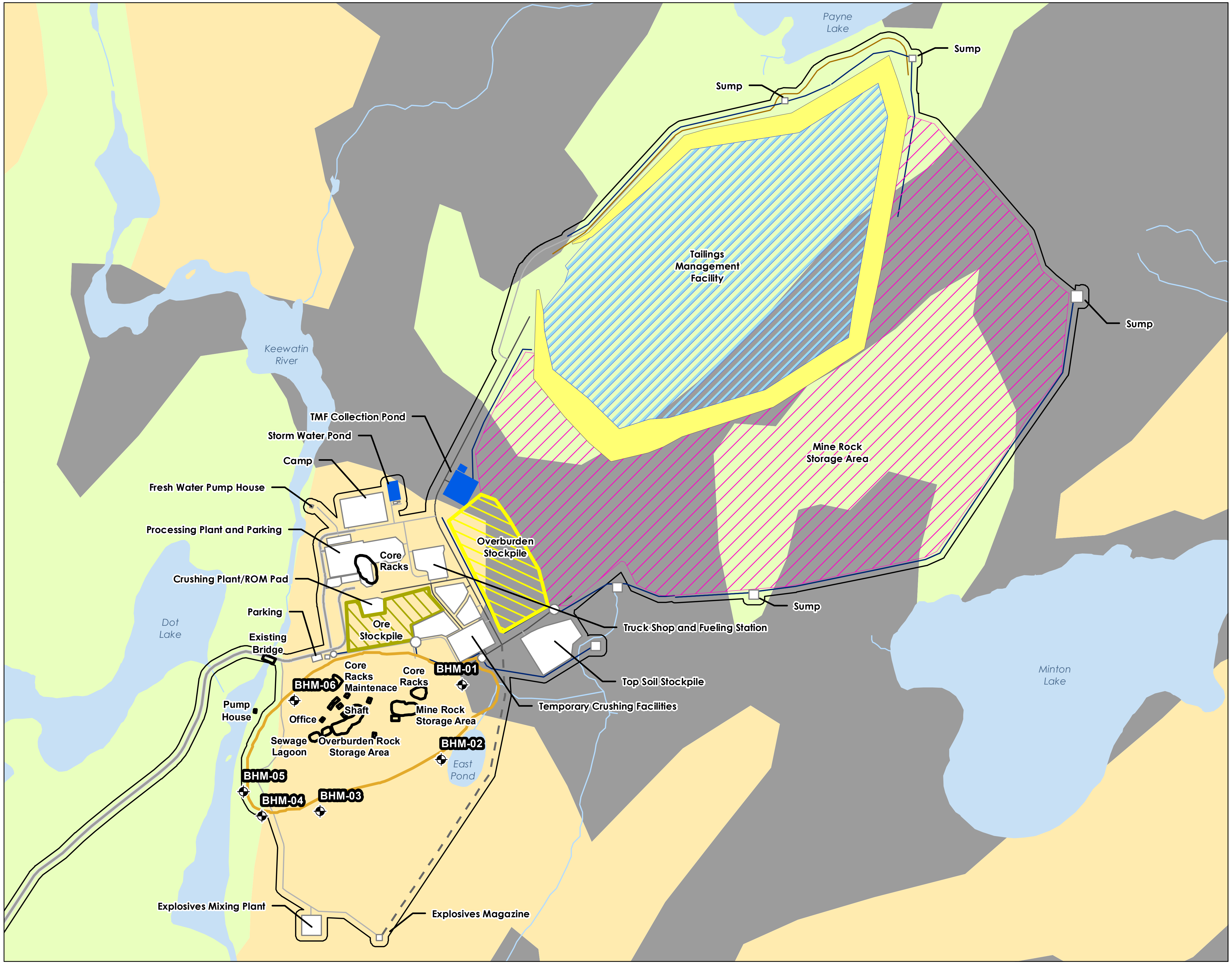

Stantec

Project Infrastructure
- ☐ Project Development Area
- ☐ Proposed Open Pit
- ▨ Proposed Mine Rock Stockpile
- ▨ Proposed Overburden Stockpile
- ▨ Proposed Ore Stockpile
- ■ Proposed Tailings Management Facility
- ▨ Proposed Tailings Management Facility Pond
- ■ Other Proposed Ponds
- ☐ Other Proposed Areas
- — Drainage Ditch
- — Access Road
- — Haul Road
- — Inplant Road
- — Toe Road
- - - Future Access Road

Overburden Sample Locations
- ⊕ Borehole Location

Historical Mine Infrastructure
- ☐ Existing Infrastructure Associated with Historical Mine

Surficial Geology
- ■ Organic Deposits
- ■ Marginal Glaciolacustrine Sediments
- ■ Sand Diamicton

Landbase
- — Existing Access Road
- ■ Waterbody
- — Watercourse

N

0 400 800 Metres
(At original document size of 11x17)
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Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada.
3. Project Infrastructure features provided by QPit and Ausenco.

Project Location
Lynn Lake,
Manitoba

Prepared by ACampigotto on 2021-01-29
Technical Review by EKhozhina on 2021-01-29

Client/Project
111473008
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-101-2

Title
Project Development Area -
MacLellan site

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Table IAAC-101-1: Coordinates of Locations of Overburden Samples at Gordon Site

Borehole	Sample ID	Northing	Easting	Comments
BHF-01	BHF 01 SA-06	N 6307997.00	E 411980.00	Open pit soil
	BHF-01 sample SA-01			
	BHF-01 sample SA-02			
BHF-02	BHF 02 SA-02	N 6307607.00	E 412486.00	Open pit soil
	BHF 02 SA-04			
	BHF-02 sample SA 1 of 2			
	BHF-02 sample SA-03			
	BHF-02 sample SA-01			
	BHF-02 sample SA-05			
BHF-03	BHF 03 SA-01	N 6307758.00	E 412833.00	Open pit soil
	BHF-03 sample SA-03B			
BHF-04	BHF-04 sample SA-01A	N 6307897.00	E 412792.00	Open pit soil
	BHF-04 sample SA-01B			
	BHF-04 sample SA-02			
	BHF-04 sample SA-03B			
BHF-05	BHF-05 sample SA-01B	N 6307989.00	E 412765.00	Open pit soil
	BHF-05 sample SA-04			
	BHF-05 sample SA-06			
	BHF-05 sample SA-10			
	BHF-05 sample SA-11			
	BHF-05 sample SA-13			
BHF-06	BHF-06 sample SA-02	N 6308017.00	E 412631.00	Open pit soil
	BHF-06 sample SA-04			
	BHF-06 sample SA-06			

Table IAAC-101-2: Coordinates of Locations of Overburden Samples at MacLellan Site

Borehole	Sample ID	Northing	Easting	Comments
BHM-01	BHM-01 sample 11 1 of 2	N 6307728.00	E 381419.00	Open pit soil
	BHM-01 sample 11 2 of 2			
	BHM-01 sample 13			
	BHM-01 sample 9			
	BHM-01 5			
	BHM-01 7			
	BHM-01 8			
	BHM-01 18			
	BHM-01 1			
BHM-2	BHM-2 sample 3	N 6307350.00	E 381314.00	Open pit soil
	BHM-2 sample 5			
BHM-03	BHM-03 sample 1	N 6307086.00	E 380701.00	Open pit soil
	BHM-03 2B			
	BHM-03 4			
	BHM-03 6			
BHM-04	BHM-04 1	N 6307062.00	E 380406.00	Open pit soil
BHM-05	BHM-05 sample 5	N 6307186.00	E 380312.00	Open pit soil
	BHM-05 sample 7A			
	BHM-05 sample 8			
	BHM-05 4			
	BHM-05 6			
	BHM-05 7B			
BHM-06	BHM-06 sample 2	N 6307647.00	E 380570.00	Open pit soil
	BHM-06 sample 1B			
	BHM-06 1A			

A.19 ATTACHMENT IAAC-102

IAAC-102-1: Estimates of ARD on set time

Parameter		Sample NP	last 5 week Ave SO4	last 5 week Ave Acidity (as CaCO3)	last 5 week Ave Alkalinity, Total (as CaCO3)	last 5 weeks NP rate (as CaCO3)	last 5 weeks AP rate (as CaCO3)	ARD onset time
Unit	Describtion	CaCO3 kg/t	mg/kg/week	mg/kg/week	mg/kg/week	mg/kg/week	mg/kg/week	years
CND 4P	Gordon tailings	17	29.3	0.9	8.81	38.3	30.5	8
CND 6	Gordon low grade ore tailings	29	8.7	1.0	12.48	20.5	9.0	27
CND 3P	MacLellan tailings	52.4	19.8	1.0	12.0	31.6	20.6	32
CND 5	MacLellan low grade ore tailings	62.6	15.6	1.0	16.1	31.4	16.2	38
CND 2P	Master Composite (MacLellan+Gordon)	36.4	6.8	0.9	16.7	22.9	7.1	30

A.20 ATTACHMENT IAAC-104

Table IAAC-104-1 Summary of Tailings Management Options

Option	Legally Acceptable?	Technically Feasible?	Economically Feasible?	Environmental / Socio-Economic Considerations	Preferred Option
Conventional Disposal	Yes	Yes	Yes	Mitigation of groundwater seepage Post-closure chemical stability considerations.	Yes
Filtered Tailings ("Dry Stack")	Yes	Yes, however: less storage capacity as compared with conventional disposal based on selected location. Would require a separate filtration plant with tailings trucked to disposal location. Difficult to achieve compaction of tailings during winter months times of high precipitation Requires more diversion of clean contact water as compared with conventional disposal option. Higher oversight of water management during operation Any PAG tailings would require a separate facility for sub-aqueous to conventional disposal or require the need for a fully lined filtered tailings stack.	No, based on planned production rates.	Not assessed further*	No
Co-Disposal (tailings and mine rock)	Yes	Yes, though storage efficiency less than conventional as facility rises based on selected location Requires more diversion of clean contact water as compared with conventional disposal option. Mitigation of ARD/ML would need to be carefully planned	Yes, though life of mine operational costs for hauling and placement of rock and hauling or pumping of tailings to meet stability requirements likely comparable to	Not assessed further*	No

Table IAAC-104-1 Summary of Tailings Management Options

Option	Legally Acceptable?	Technically Feasible?	Economically Feasible?	Environmental / Socio-Economic Considerations	Preferred Option
			life of mine dam construction costs for conventional disposal.		
* Not assessed further as it was determined to be not legally, technically, and/or economically feasible.					

A.21 ATTACHMENT IAAC-105

Table IAAC-105-1 Summary of Mine Rock Disposal Options – Gordon site

Option	Legally Acceptable?	Technically Feasible?	Economically Feasible?	Environmental / Socio-Economic Considerations	Preferred Option
Placement of Soil Cover at Gordon MRSA at Closure	Yes	Yes	Yes	Geotechnical slope stability analyses will be carried out by a Qualified Professional Engineer at the time of closure to confirm the stability of the mine rock. Slope regrading is proposed to allow placement of cover material on the slopes and revegetation to occur. Runoff and toe seepage will continue to be collected by the perimeter contact water collection ditches. The closure trench will drain collected seepage water to the Gordon pit.	Yes
Disposal of Mine Rock in the Gordon Open Pit	Yes	Yes, however would require double handling of material.	No, due to the costs associated with recovery and hauling of material.	Not assessed further*	No
* Not assessed further as it was determined to be not legally, technically, and/or economically feasible.					

A.22 ATTACHMENT IAAC-106

Table IAAC-106-1 Summary of Mine Rock and Tailings Disposal Options – MacLellan site

Option	Legally Acceptable?	Technically Feasible?	Economically Feasible?	Environmental / Socio-Economic Considerations	Preferred Option
Placement of a Soil Cover at MacLellan MRSA and TMF at Closure	Yes	Yes	Yes	Geotechnical slope stability analyses will be carried out by a Qualified Professional Engineer at the time of closure to confirm the stability of the mine rock. Slope regrading is proposed to allow placement of cover material on the slopes and revegetation to occur. Runoff and toe seepage will continue to be collected by the perimeter contact water collection ditches. The closure trench will drain collected seepage water to the MacLellan pit.	Yes
Disposal of Mine Rock and Tailings in the MacLellan Open Pit	Yes	Yes, however would require double handling of material.	No, due to the costs associated with recovery and hauling of material.	Not assessed further*	No
* Not assessed further as it was determined to be not legally, technically, and/or economically feasible.					

A.23 ATTACHMENT IAAC-107

Table IAAC-107-1a Hydrostratigraphic Units Which Particles Travel Through from Source to Receptor – Gordon site

Project Phase	Project Facility		
	Historical North MRSA	Historical South MRSA	New MRSA
Baseline	• Organics • Glaciolacustrine Nearshore • Shallow Bedrock	• Organics • Glaciolacustrine Nearshore • Shallow Bedrock	• Not applicable
Construction	• Shallow Bedrock	• Shallow Bedrock	• Not applicable
Operation	• Shallow Bedrock	• Shallow Bedrock	• Glaciolacustrine Nearshore • Glaciolacustrine Offshore • Shallow Bedrock
Closure	• Organics • Glaciolacustrine Nearshore • Shallow Bedrock	• Organics • Glaciolacustrine Nearshore • Shallow Bedrock	• Glaciolacustrine Nearshore • Glaciolacustrine Offshore • Shallow Bedrock

Table IAAC-107-1b Hydrostratigraphic Units Which Particles Travel Through From Source to Receptor – MacLellan site

Project Phase	Project Facility	
	New MRSA	TMF
Baseline	• Organics • Diamicton • Glaciolacustrine • Shallow Bedrock	• Organics • Diamicton • Glaciolacustrine • Shallow Bedrock
Construction	• Organics • Diamicton • Glaciolacustrine • Shallow Bedrock	• Organics • Diamicton • Glaciolacustrine • Shallow Bedrock
Operation	• Organics • Diamicton • Glaciolacustrine • Shallow Bedrock	• Organics • Diamicton • Glaciolacustrine • Shallow Bedrock
Closure	• Organics • Diamicton • Glaciolacustrine	• Organics • Diamicton • Glaciolacustrine

A.24 ATTACHMENT IAAC-114

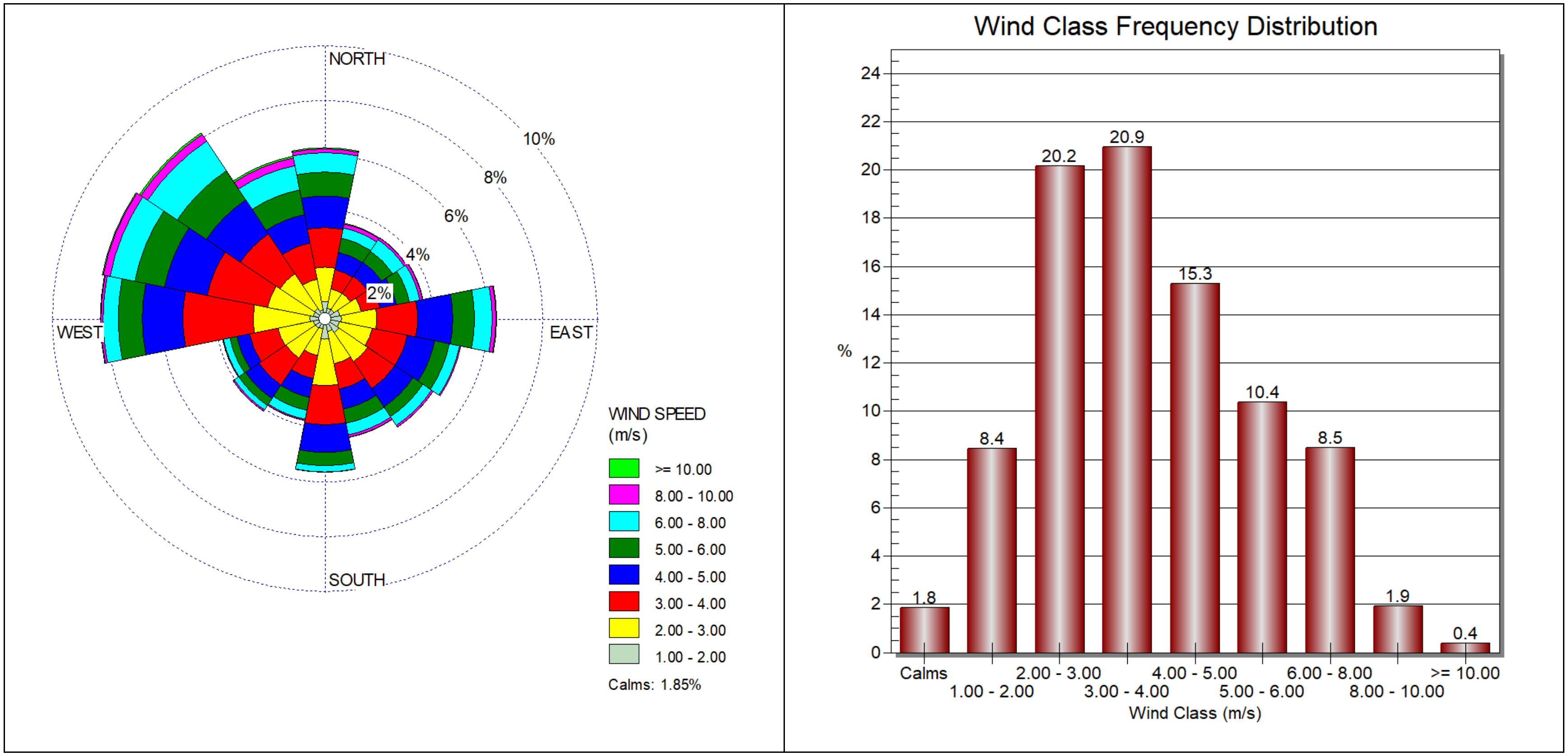
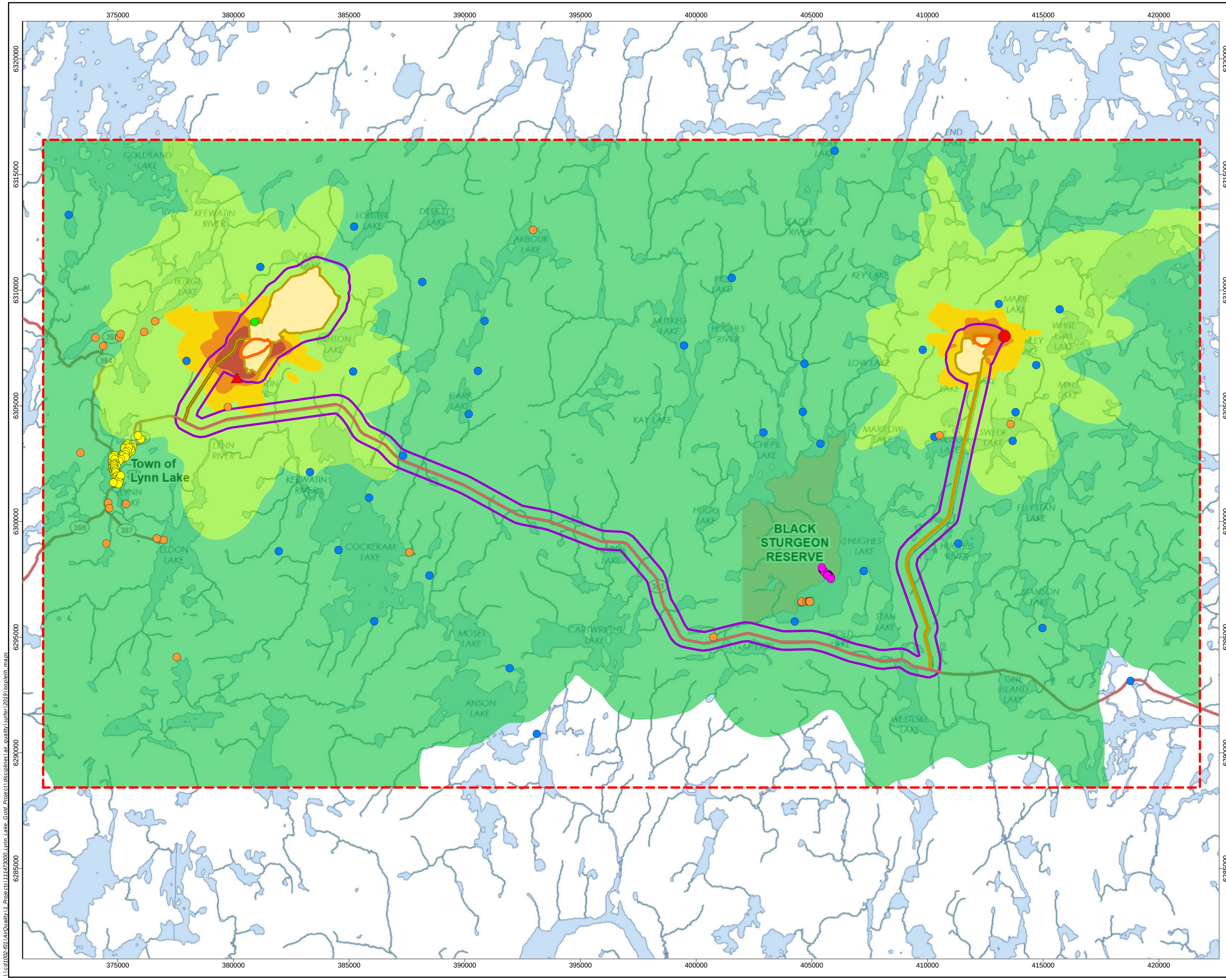


Figure IAAC-114-1 Wind Rose and Wind Frequency Distribution Diagram at Lynn Lake Airport, Manitoba (2015-2018) (Updated Figure 6A-1 from Chapter 6 of the EIS)

A.25 ATTACHMENT IAAC-115



Stantec

ALAMOS GOLD INC.

Study Area

- 🟧 Proposed Open Pit
- 🟨 Project Development Area
- 🟪 Project Boundary
- ⬚ Air Quality Local Assessment Area

Human Receptors

- ● Lynn Lake Receptors
- ● Black Sturgeon Reserve Receptors
- ● Human Receptors
- ● Potential Indigenous Receptor
- ● Worker Camp

Landbase

- ━ Highway
- ═ Access Road
- ━ Watercourse
- 🟦 Waterbody
- 🟥 First Nation Reserve

Maximum Concentrations

- ● Maximum Concentration (Gordon Site): 459 µg/m^3
- ▲ Maximum Concentration (MacLellan Site): 404 µg/m^3

Background Concentration:7.5 µg/m^3

1-hour NO_2 MAAQC: 400 µg/m^3

🟩	🟩	🟨	🟧	🟥
40	100	200	300	400

N

0 1500 3000 4500 6000 Metres

(At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

Project Location
Lynn Lake,
Manitoba

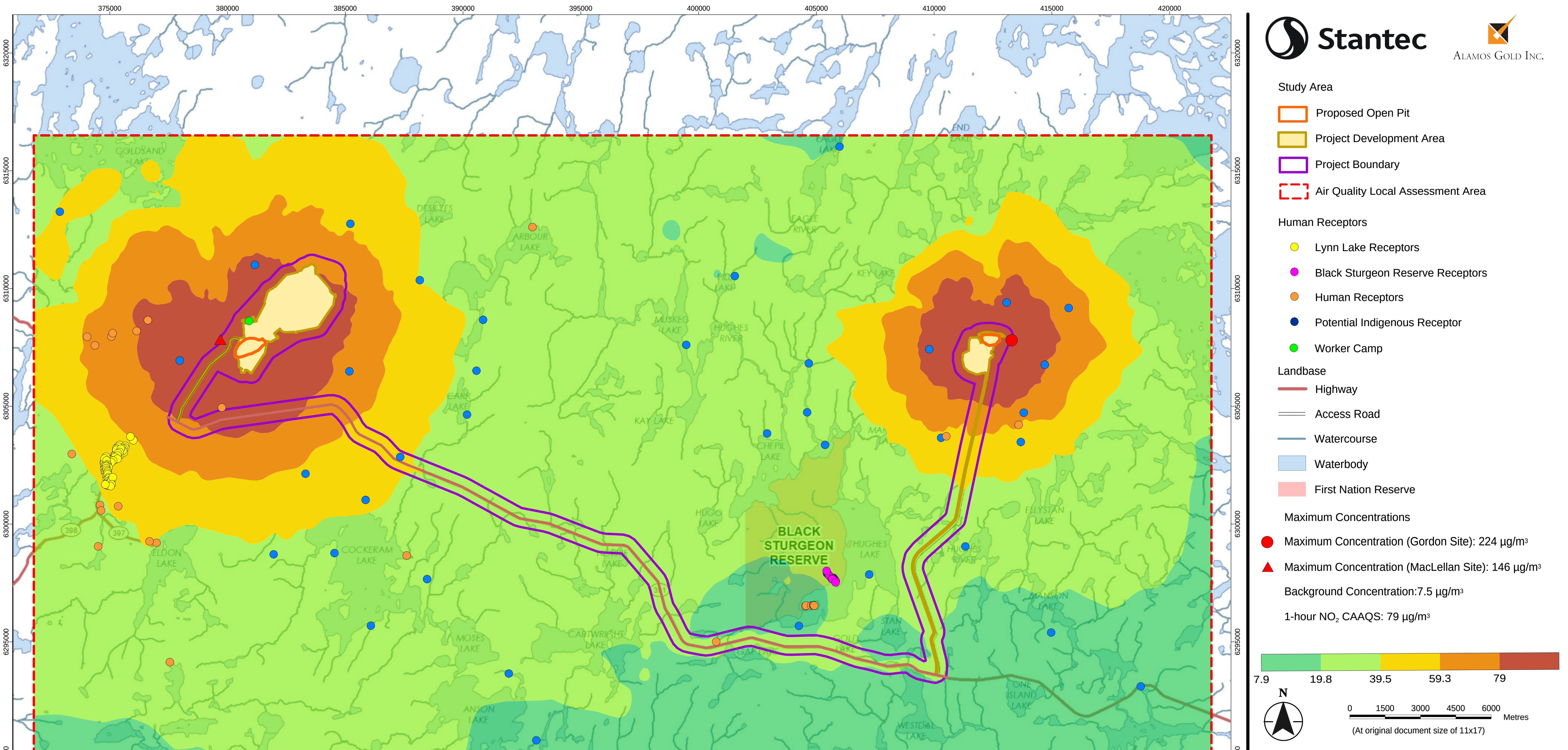
Prepared by IYankova on 2021-05-31
Technical Review by DJarratt on 2021-06-01

Client/Project 111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-115-1

Title

Maximum Predicted 1-hour Average NO_2 Concentrations (µg/m^3) (Project Operation + Baseline Conditions)



Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

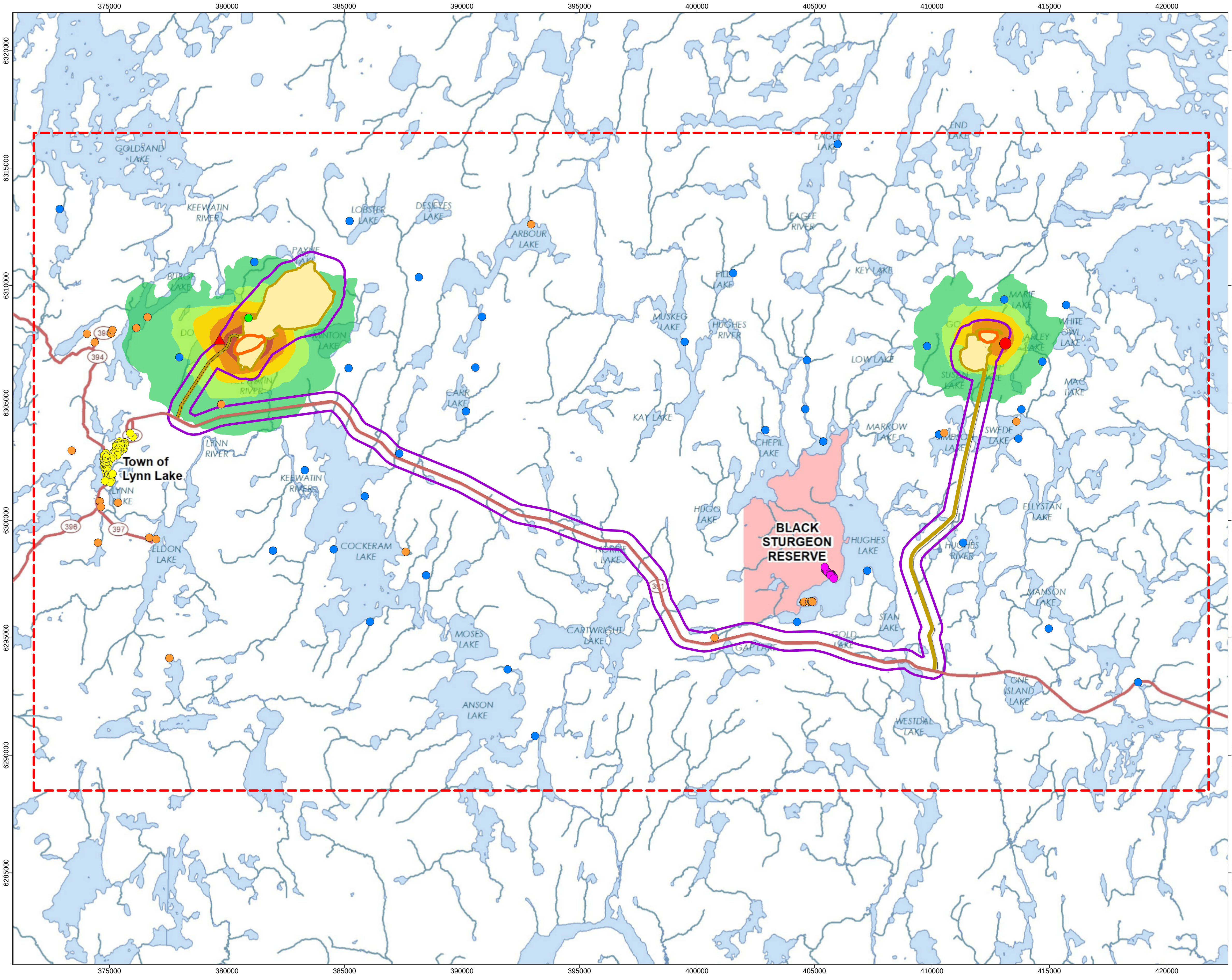
Project Location
Lynn Lake,
Manitoba

Prepared by IYankova on 2021-05-31
Technical Review by DJarratt on 2021-06-01

Client/Project
111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-115-2

Title
Maximum Predicted 98% Daily 1-hour Average NO_2 Concentrations (Project Operation + Baseline Conditions)



\\cd1002-f01\AirQuality\1_Projects\111473000_Lynn_Lake_Gold_Project\disciplines\air_quality\surfer\2019\isopleth_maps

Stantec

ALAMOS GOLD INC.

Study Area

- 🟧 Proposed Open Pit
- 🟨 Project Development Area
- 🟪 Project Boundary
- 🟥 Air Quality Local Assessment Area

Human Receptors

- ● Lynn Lake Receptors
- ● Black Sturgeon Reserve Receptors
- ● Human Receptors
- ● Potential Indigenous Receptor
- ● Worker Camp

Landbase

- Highway
- Access Road
- Watercourse
- Waterbody
- First Nation Reserve

Maximum Concentrations

- ● Maximum Exceedances (Gordon Site): 99 days/year
- ▲ Maximum Exceedances (MacLellan Site): 79 days/year

Background Concentration: 7.5 µg/m3

1-hour NO_2 CAAQS: 79 µg/m3

1 15 30 50 90

N

0 1500 3000 4500 6000 Metres

(At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

Project Location
Lynn Lake,
Manitoba

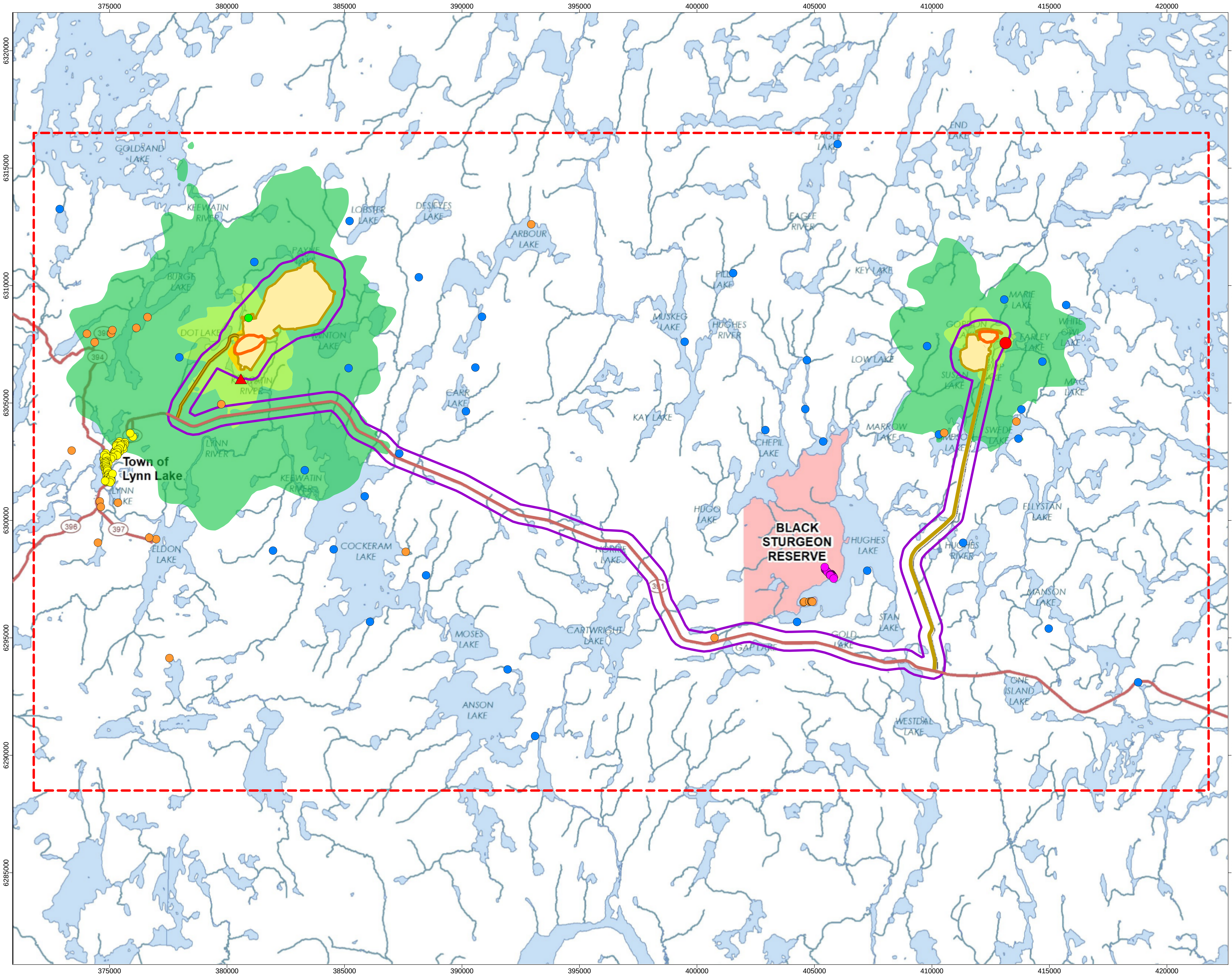
Prepared by IYankova on 2021-05-31
Technical Review by DJarratt on 2021-06-01

Client/Project 111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-115-3

Title

Maximum Frequency Exceedance of 98% Daily 1-hour Average NO_2 Concentrations (Project Operation + Baseline Conditions)



Stantec

ALAMOS GOLD INC.

Study Area

- 🟧 Proposed Open Pit
- 🟨 Project Development Area
- 🟪 Project Boundary
- 🟥 Air Quality Local Assessment Area

Human Receptors

- ● Lynn Lake Receptors
- ● Black Sturgeon Reserve Receptors
- ● Human Receptors
- ● Potential Indigenous Receptor
- ● Worker Camp

Landbase

- Highway
- Access Road
- Watercourse
- Waterbody
- First Nation Reserve

Maximum Concentrations

- ● Maximum Concentration (Gordon Site): 74.1 µg/m³
- ▲ Maximum Concentration (MacLellan Site): 84.5 µg/m³

Background Concentration:5.6 µg/m³

24-hour NO_2 MAAQC: 200 µg/m³

20 50 100 150 200

N

0 1500 3000 4500 6000 Metres

(At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

Project Location
Lynn Lake,
Manitoba

Prepared by IYankova on 2021-05-31
Technical Review by DJarratt on 2021-06-01

Client/Project
111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

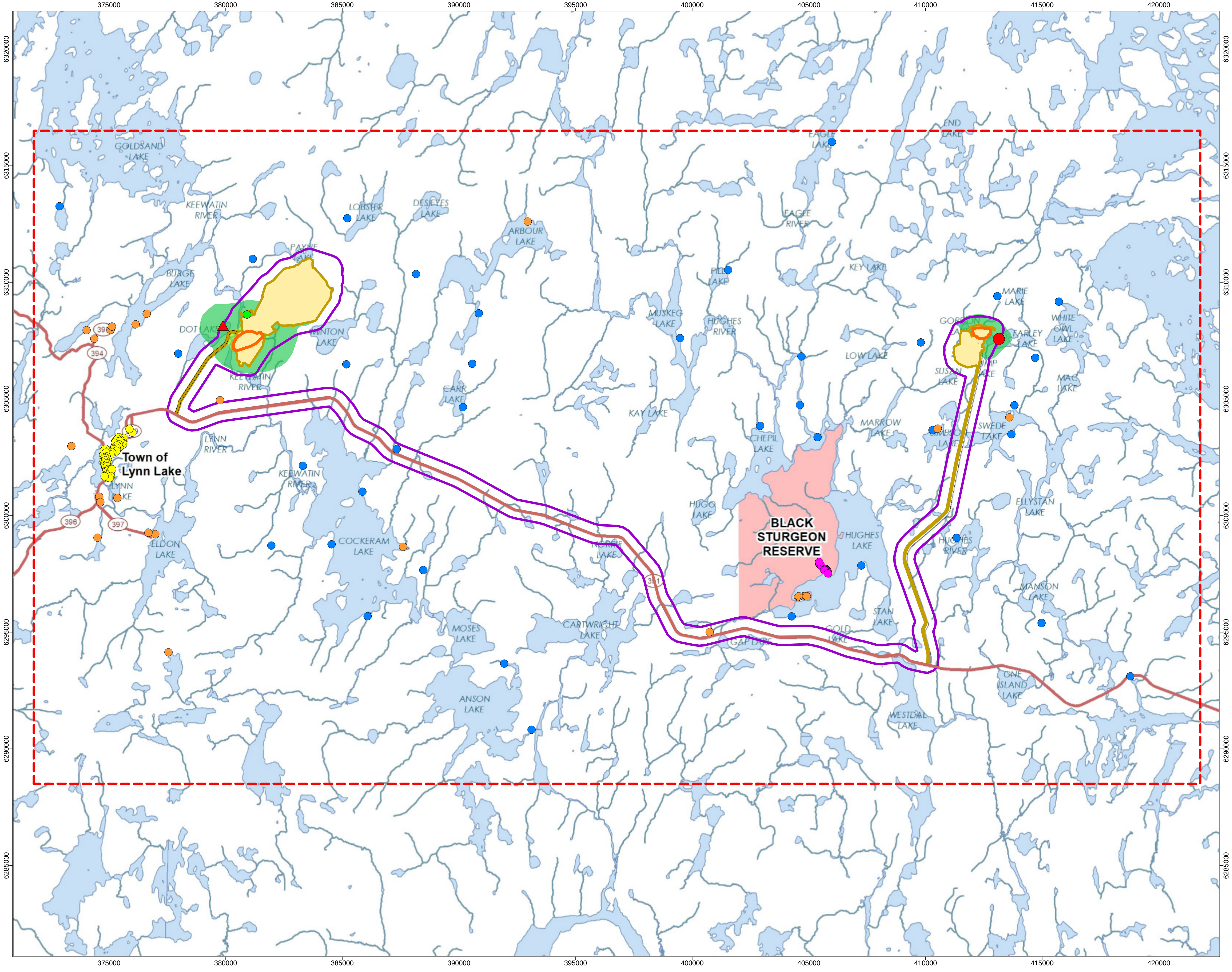
Map No.
IAAC-115-4

Title

Maximum Predicted 24-hour Average NO_2 Concentrations (µg/m³) (Project Operation + Baseline Conditions)

\\cd1002-f01\AirQuality\1_Projects\111473000_Lynn_Lake_Gold_Project\disciplines\air_quality\surfer\2019\isopleth_maps

\\cd1002-f01\AirQuality\1_Projects\111473000_Lynn_Lake_Gold_Project\disciplines\air_quality\surfer\2019\isopleth_maps



Stantec

ALAMOS GOLD INC.

Study Area

🟧 Proposed Open Pit

🟨 Project Development Area

🟪 Project Boundary

🟥 Air Quality Local Assessment Area

Human Receptors

● Lynn Lake Receptors

● Black Sturgeon Reserve Receptors

● Human Receptors

● Potential Indigenous Receptor

● Worker Camp

Landbase

— Highway

═ Access Road

— Watercourse

🟦 Waterbody

🟥 First Nation Reserve

Maximum Concentrations

● Maximum Concentration (Gordon Site): 11.2 µg/m³

▲ Maximum Concentration (MacLellan Site): 9.03 µg/m³

Background Concentration:1.9 µg/m³

Annual NO_2 MAAQC: 60 µg/m³

🟩	🟩	🟨	🟧	🟥
6	15	30	45	60

N

0 1500 3000 4500 6000 Metres

(At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

Project Location
Lynn Lake,
Manitoba

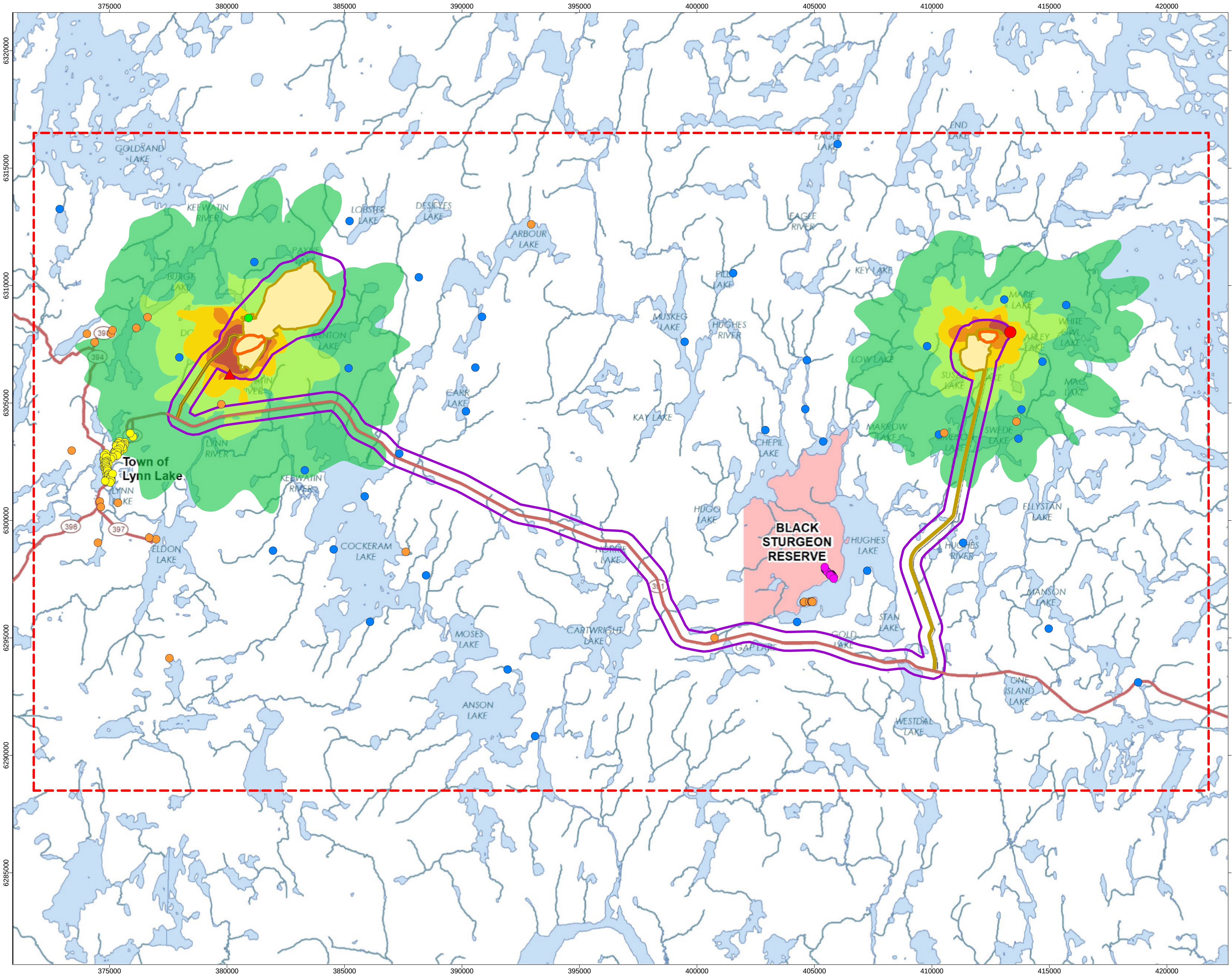
Prepared by IYankova on 2021-05-31
Technical Review by DJarratt on 2021-06-01

Client/Project
111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-115-5

Title

Maximum Predicted Annual Average NO_2 Concentrations (µg/m³) (Project Operation + Baseline Conditions)



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Stantec

ALAMOS GOLD INC.

Study Area
- Proposed Open Pit
- Project Development Area
- Project Boundary
- Air Quality Local Assessment Area

Human Receptors
- ● Lynn Lake Receptors
- ● Black Sturgeon Reserve Receptors
- ● Human Receptors
- ● Potential Indigenous Receptor
- ● Worker Camp

Landbase
- Highway
- Access Road
- Watercourse
- Waterbody
- First Nation Reserve

Maximum Concentrations
- ● Maximum Concentration (Gordon Site): 16096 µg/m³
- ▲ Maximum Concentration (MacLellan Site): 13328 µg/m³

Background Concentration:406 µg/m³

1-hour CO MAAQC: 15000 µg/m³

1500 3750 7500 11250 15000

N

0 1500 3000 4500 6000 Metres

(At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

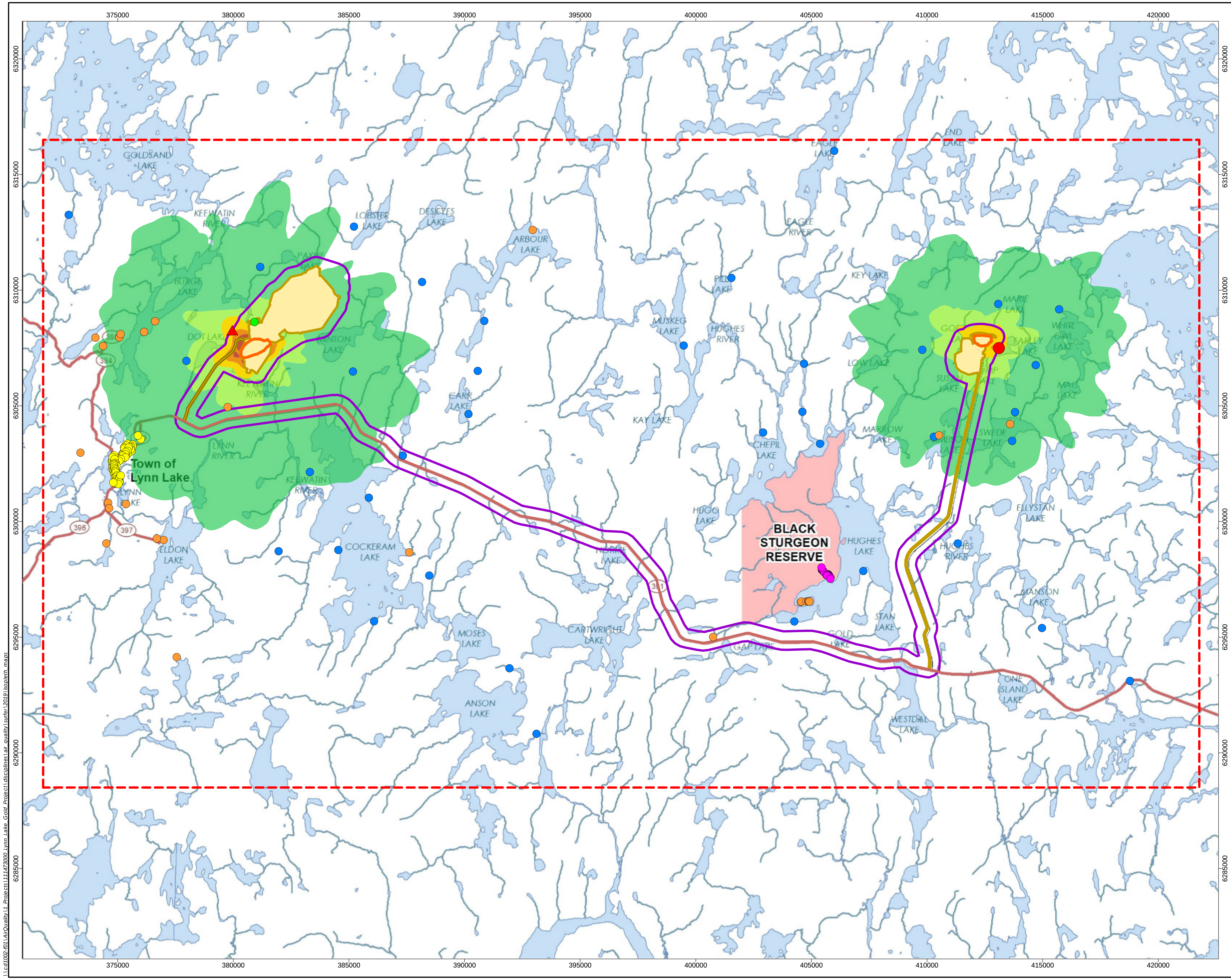
Project Location
Lynn Lake,
Manitoba

Prepared by IYankova on 2021-05-31
Technical Review by DJarratt on 2021-06-01

Client/Project 111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-115-6

Title
Maximum Predicted 1-hour Average CO Concentrations (µg/m³) (Project Operation + Baseline Conditions)



Stantec

Alamos Gold Inc.

Study Area

🟧 Proposed Open Pit

🟨 Project Development Area

🟪 Project Boundary

▭ Air Quality Local Assessment Area

Human Receptors

● Lynn Lake Receptors

● Black Sturgeon Reserve Receptors

● Human Receptors

● Potential Indigenous Receptor

● Worker Camp

Landbase

— Highway

═ Access Road

— Watercourse

▨ Waterbody

🟥 First Nation Reserve

Maximum Concentrations

● Maximum Concentration (Gordon Site): 4952 μg/m³

▲ Maximum Concentration (MacLellan Site): 4144 μg/m³

Background Concentration:406 μg/m³

8-hour CO MAAQC: 6000 μg/m³

🟩	🟩	🟨	🟧	🟥
600	1500	3000	4500	6000

N

0 1500 3000 4500 6000 Metres

(At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

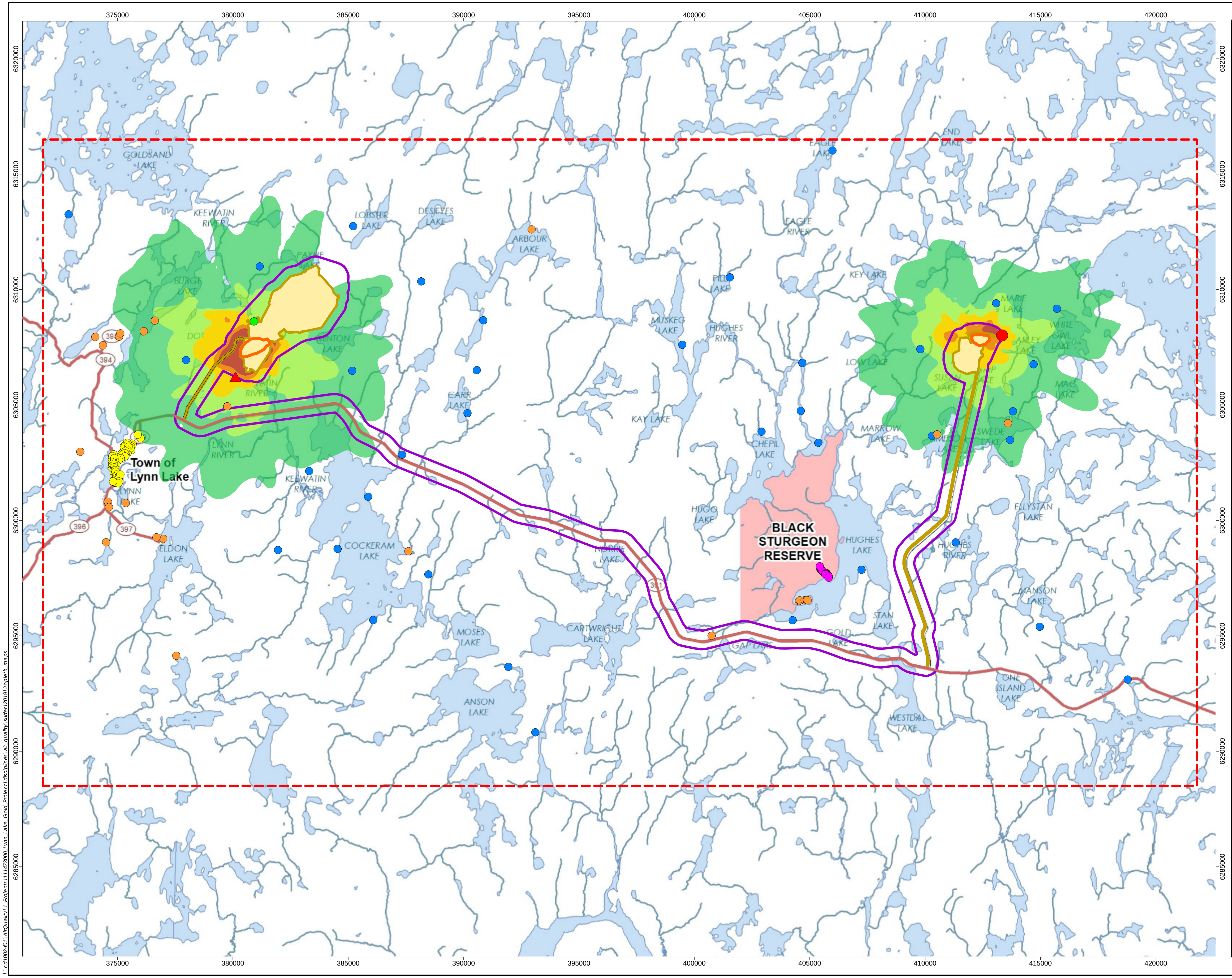
Project Location
Lynn Lake,
Manitoba

Prepared by IYankova on 2021-05-31
Technical Review by DJarratt on 2021-06-01

Client/Project 111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-115-7

Title
Maximum Predicted 8-hour Average CO Concentrations (μg/m³) (Project Operation + Baseline Conditions)



Stantec

Alamos Gold Inc.

Study Area

- 🟧 Proposed Open Pit
- 🟨 Project Development Area
- 🟪 Project Boundary
- ⬚ Air Quality Local Assessment Area

Human Receptors

- ● Lynn Lake Receptors
- ● Black Sturgeon Reserve Receptors
- ● Human Receptors
- ● Potential Indigenous Receptor
- ● Worker Camp

Landbase

- ─ Highway
- ═ Access Road
- ─ Watercourse
- ▭ Waterbody
- ▭ First Nation Reserve

Maximum Concentrations

- ● Maximum Concentration (Gordon Site): 460 µg/m³
- ▲ Maximum Concentration (MacLellan Site): 370 µg/m³

Background Concentration:6 µg/m³

1-hour SO_2 MAAQC: 450 µg/m³

🟩	🟩	🟨	🟧	🟥
45	113	225	338	450

(At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

Project Location
Lynn Lake,
Manitoba

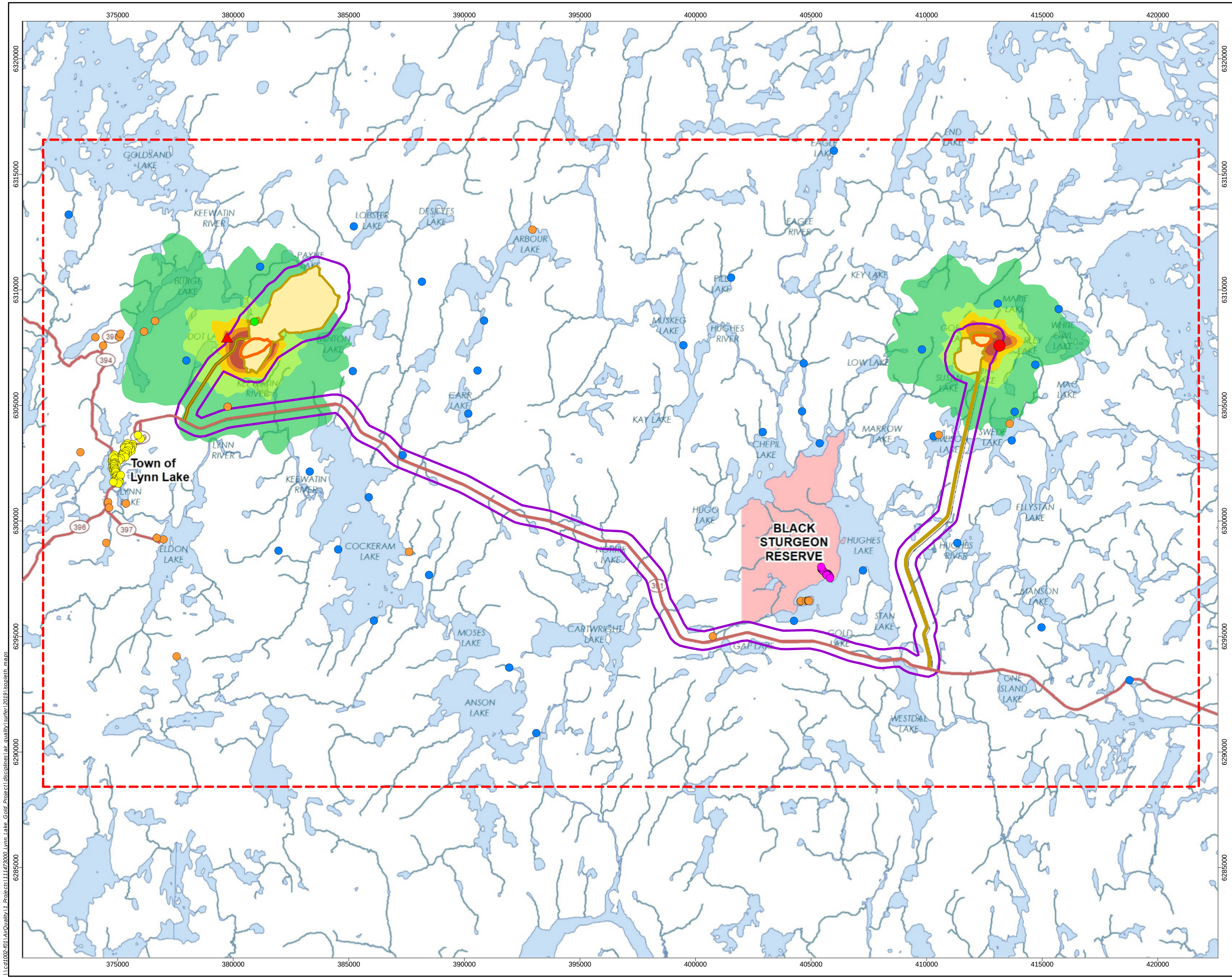
Prepared by IYankova on 2021-05-31
Technical Review by DJarratt on 2021-06-01

Client/Project 111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-115-8

Title

Maximum Predicted 1-hour Average SO_2 Concentrations (µg/m³) (Project Operation + Baseline Conditions)



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Stantec

ALAMOS GOLD INC.

Study Area

- Proposed Open Pit
- Project Development Area
- Project Boundary
- Air Quality Local Assessment Area

Human Receptors

- ● Lynn Lake Receptors
- ● Black Sturgeon Reserve Receptors
- ● Human Receptors
- ● Potential Indigenous Receptor
- ● Worker Camp

Landbase

- Highway
- Access Road
- Watercourse
- Waterbody
- First Nation Reserve

Maximum Concentrations

● Maximum Concentration (Gordon Site): 342 µg/m3

▲ Maximum Concentration (MacLellan Site): 147 µg/m3

Background Concentration:6 µg/m3

1-hour SO_2 CAAQS: 170 µg/m3

🟩	🟩	🟨	🟧	🟥

17 42.5 85 128 170

N

0 1500 3000 4500 6000 Metres

(At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

Project Location
Lynn Lake,
Manitoba

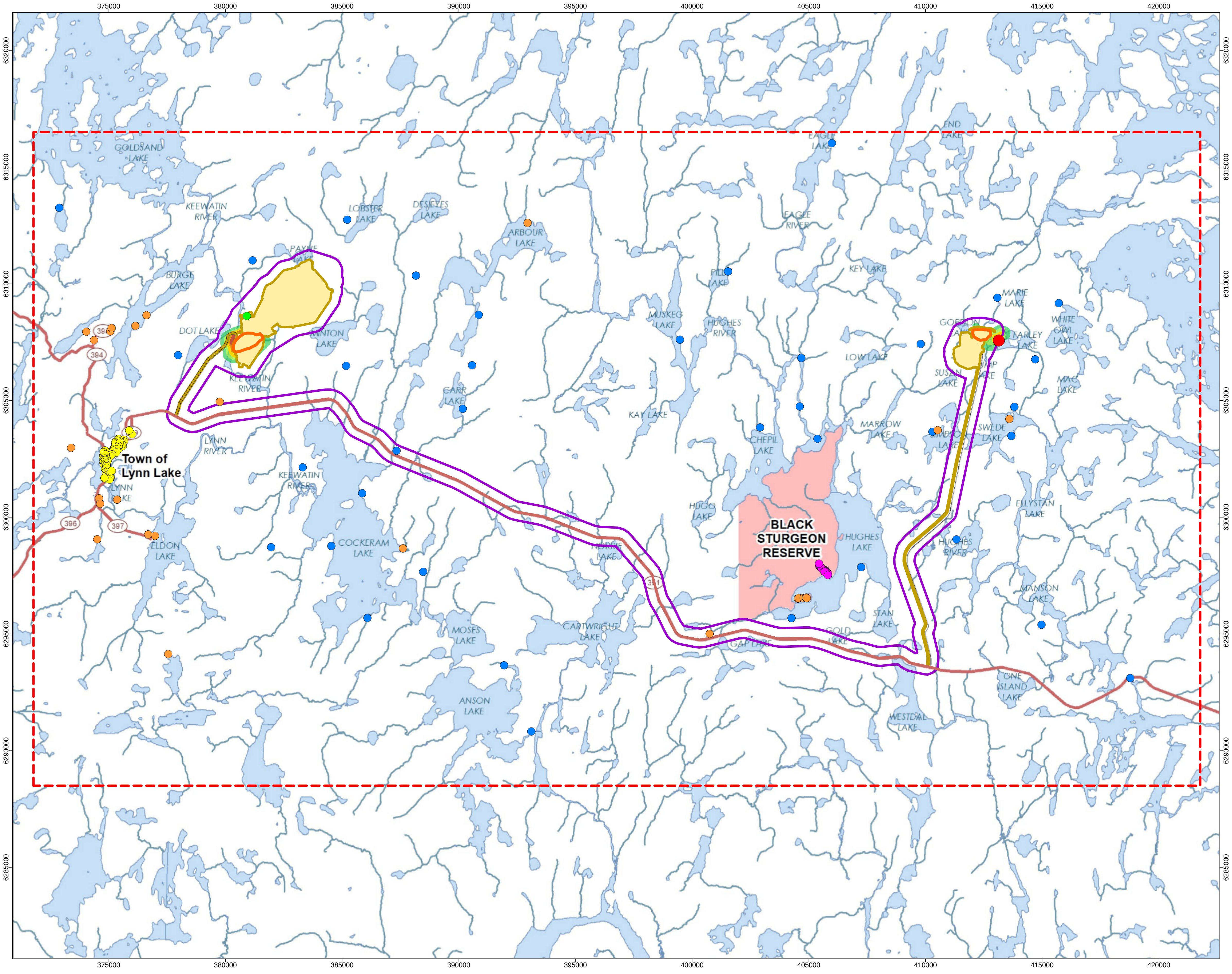
Prepared by IYankova on 2021-05-31
Technical Review by DJarratt on 2021-06-01

Client/Project 111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-115-9

Title

Maximum Predicted 99% Daily 1-hour Average SO_2 Concentrations (Project Operation + Baseline Conditions)



Stantec

ALAMOS GOLD INC.

Study Area

🟧 Proposed Open Pit

🟨 Project Development Area

🟪 Project Boundary

🟥 Air Quality Local Assessment Area

Human Receptors

● Lynn Lake Receptors

● Black Sturgeon Reserve Receptors

● Human Receptors

● Potential Indigenous Receptor

● Worker Camp

Landbase

— Highway

═ Access Road

— Watercourse

▨ Waterbody

▨ First Nation Reserve

Maximum Concentrations

● Maximum Exceedances (Gordon Site): 5 days/year

▲ Maximum Exceedances (MacLellan Site): 0 days/year

Background Concentration: 6 μg/m³

1-hour SO_2 CAAQS: 170 μg/m³

🟩	🟩	🟨	🟧	🟥

1 2 3 4 5

N

0 1500 3000 4500 6000 Metres

(At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

Project Location
Lynn Lake,
Manitoba

Prepared by IYankova on 2021-05-31
Technical Review by DJarratt on 2021-06-01

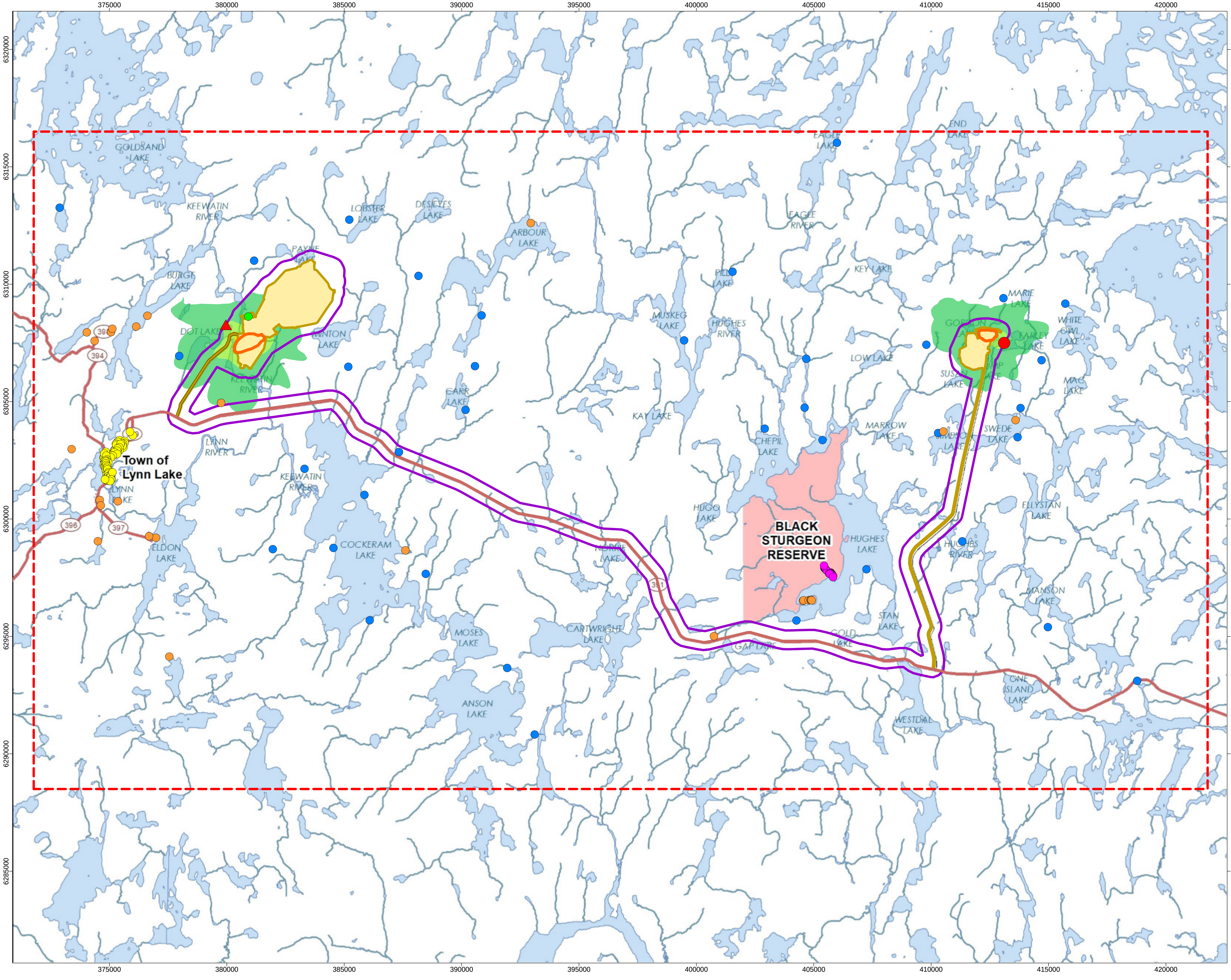
Client/Project
111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-115-10

Title

Maximum Frequency Exceedance of 99% Daily 1-hour Average SO_2 Concentrations (Project Operation + Baseline Conditions)

\\cd1002-f01\AirQuality\1_Projects\111473000_Lynn_Lake_Gold_Project\disciplines\air_quality\surfer\2019\isopleth_maps



Stantec

Alamos Gold Inc.

Study Area

🟧 Proposed Open Pit

🟨 Project Development Area

🟪 Project Boundary

🟥 Air Quality Local Assessment Area

Human Receptors

● Lynn Lake Receptors

● Black Sturgeon Reserve Receptors

● Human Receptors

● Potential Indigenous Receptor

● Worker Camp

Landbase

Highway

Access Road

Watercourse

Waterbody

First Nation Reserve

Maximum Concentrations

● Maximum Concentration (Gordon Site): 48.7 µg/m3

▲ Maximum Concentration (MacLellan Site): 39. µg/m3

Background Concentration:6 µg/m3

24-hour SO_2 MAAQC: 150 µg/m3

🟩	🟩	🟨	🟧	🟥
15	37.5	75	113	150

N

0 1500 3000 4500 6000 Metres

(At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

Project Location
Lynn Lake,
Manitoba

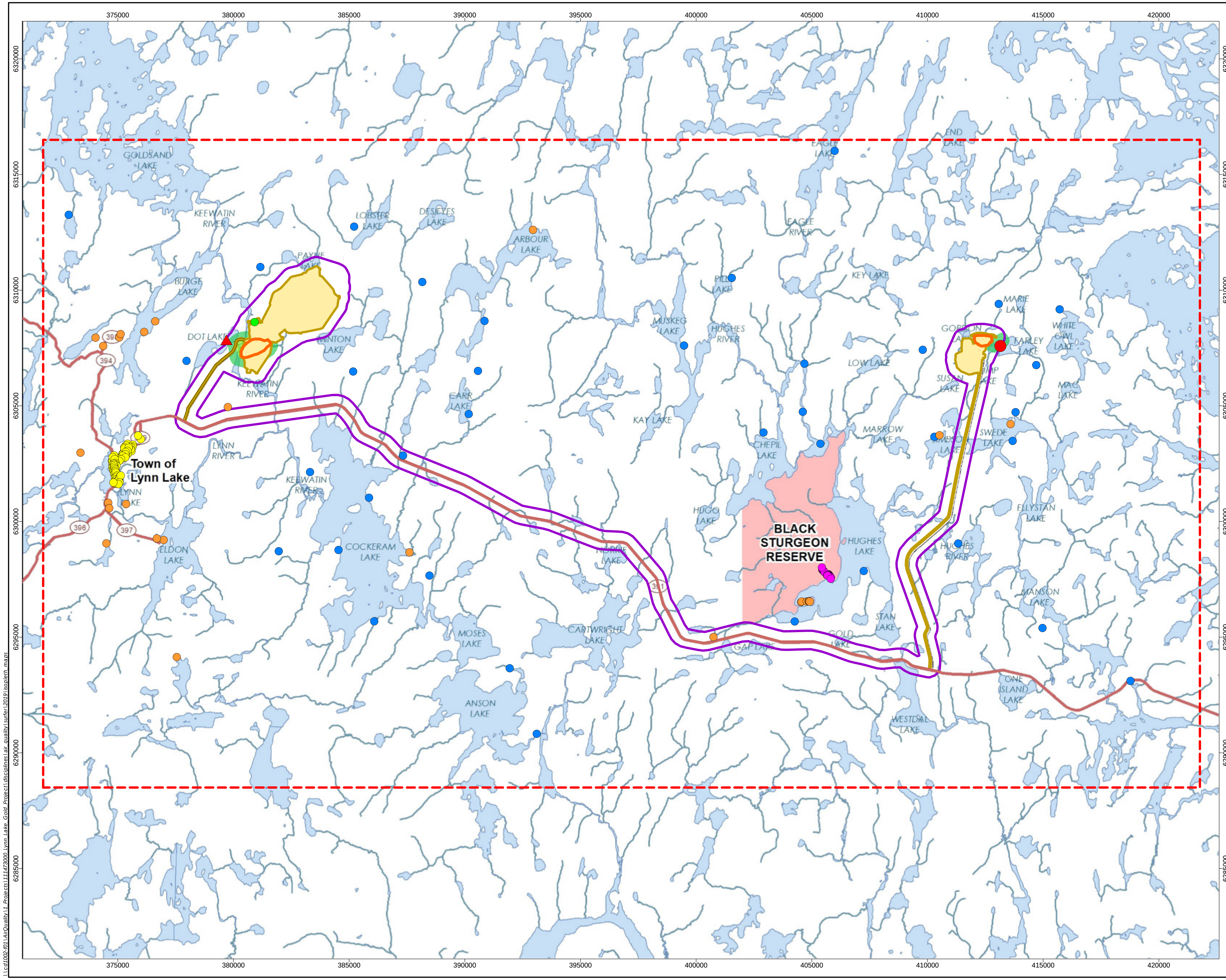
Prepared by IYankova on 2021-05-31
Technical Review by DJarratt on 2021-06-01

Client/Project 111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-115-11

Title

Maximum Predicted 24-hour Average SO_2 Concentrations (µg/m3) (Project Operation + Baseline Conditions)



Stantec

ALAMOS GOLD INC.

Study Area

🟧 Proposed Open Pit

🟨 Project Development Area

🟪 Project Boundary

🟥 Air Quality Local Assessment Area

Human Receptors

● Lynn Lake Receptors

● Black Sturgeon Reserve Receptors

● Human Receptors

● Potential Indigenous Receptor

● Worker Camp

Landbase

— Highway

═ Access Road

— Watercourse

▭ Waterbody

▭ First Nation Reserve

Maximum Concentrations

● Maximum Concentration (Gordon Site): 2.45 µg/m³

▲ Maximum Concentration (MacLellan Site): 1.95 µg/m³

Background Concentration:1.5 µg/m³

Annual SO_2 CAAQS: 10 µg/m³

🟩	🟩	🟨	🟧	🟥
2	2.5	5	7.5	10

N

0 1500 3000 4500 6000 Metres

(At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

Project Location
Lynn Lake,
Manitoba

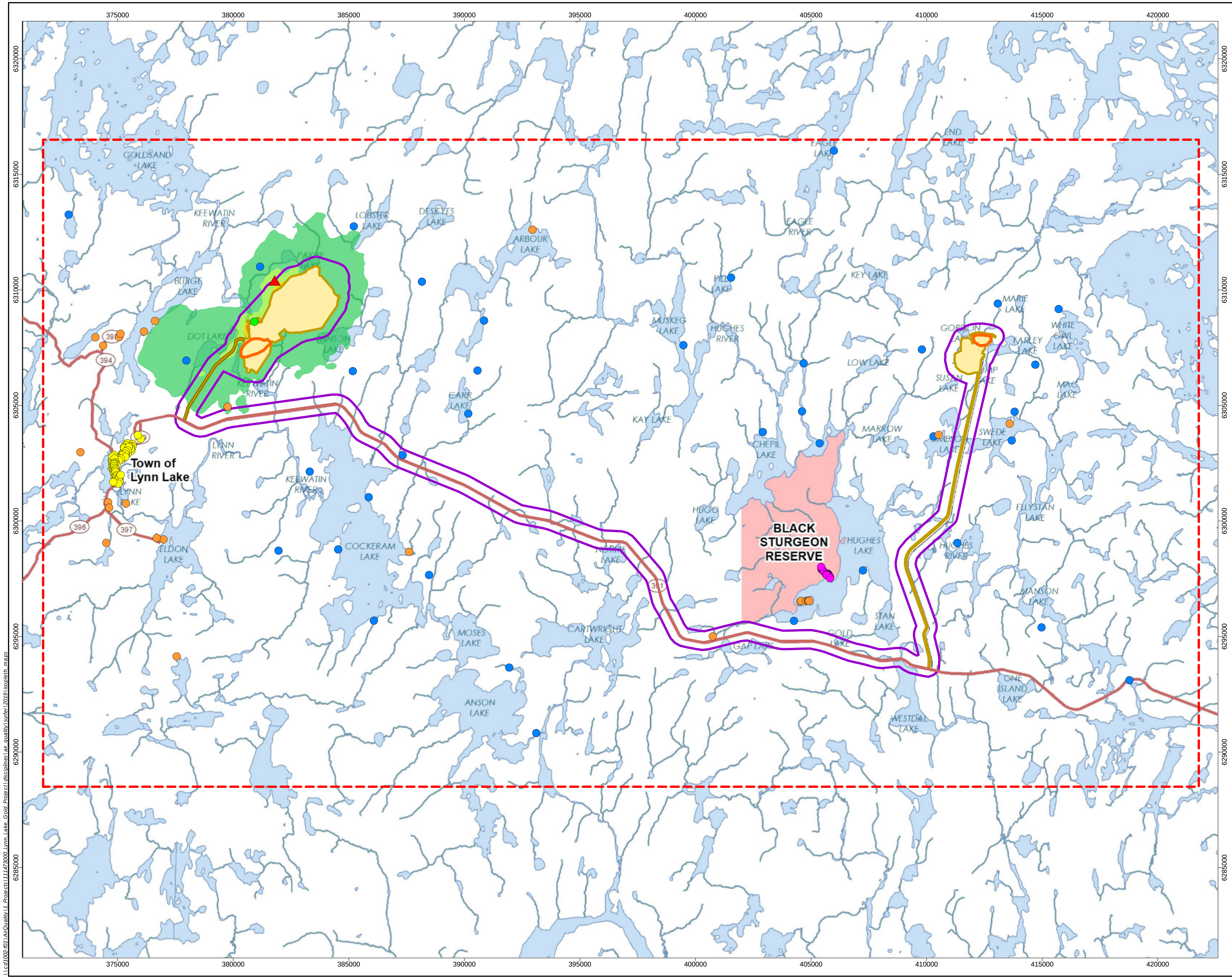
Prepared by IYankova on 2021-05-31
Technical Review by DJarratt on 2021-06-01

Client/Project 111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-115-12

Title

Maximum Predicted Annual Average SO_2 Concentrations (µg/m³) (Project Operation + Baseline Conditions)



Stantec

Alamos Gold Inc.

Study Area

🟧 Proposed Open Pit

🟨 Project Development Area

🟪 Project Boundary

▭ Air Quality Local Assessment Area

Human Receptors

● Lynn Lake Receptors

● Black Sturgeon Reserve Receptors

● Human Receptors

● Potential Indigenous Receptor

● Worker Camp

Landbase

— Highway

═ Access Road

— Watercourse

▭ Waterbody

▭ First Nation Reserve

Maximum Concentrations

● Maximum Concentration (Gordon Site): 0 µg/m³

▲ Maximum Concentration (MacLellan Site): 14.4 µg/m³

Background Concentration:0 µg/m³

1-hour HCN MAAQC: 40 µg/m³

4 10 20 30 40

N

0 1500 3000 4500 6000 Metres

(At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

Project Location
Lynn Lake,
Manitoba

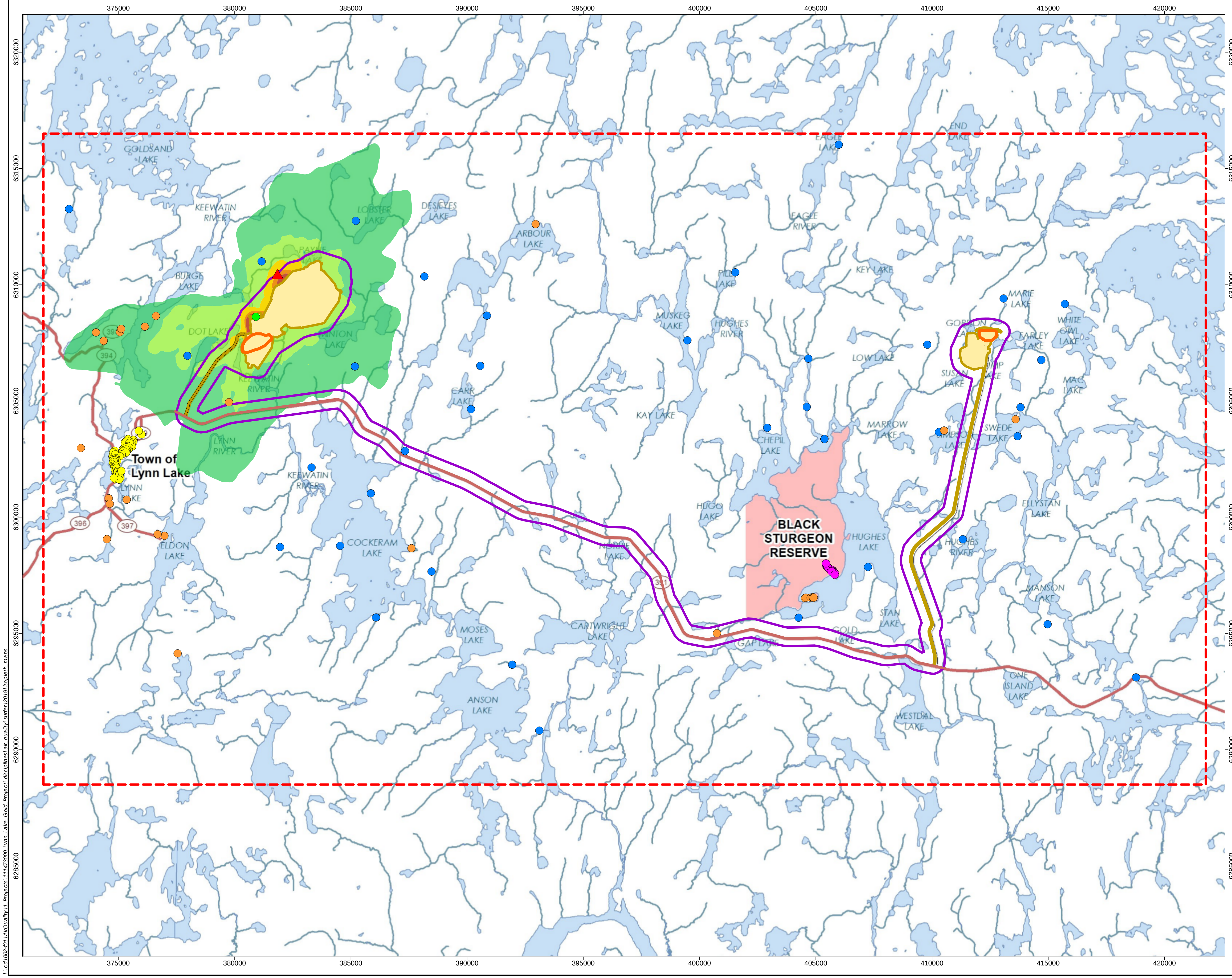
Prepared by IYankova on 2021-05-31
Technical Review by DJarratt on 2021-06-01

Client/Project 111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-115-13

Title

Maximum Predicted 1-hour Average HCN Concentrations (µg/m³) (Project Operation + Baseline Conditions)



Stantec

Alamos Gold Inc.

Study Area

🟧 Proposed Open Pit

🟨 Project Development Area

🟪 Project Boundary

🟥 Air Quality Local Assessment Area

Human Receptors

● Lynn Lake Receptors

● Black Sturgeon Reserve Receptors

● Human Receptors

● Potential Indigenous Receptor

● Worker Camp

Landbase

— Highway

═ Access Road

— Watercourse

▭ Waterbody

▭ First Nation Reserve

Maximum Concentrations

● Maximum Concentration (Gordon Site): 0 µg/m³

▲ Maximum Concentration (MacLellan Site): 6.50 µg/m³

Background Concentration:0 µg/m³

24-hour HCN OAAQC: 8 µg/m³

0.8 2 4 6 8

N

0 1500 3000 4500 6000 Metres

(At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

Project Location
Lynn Lake,
Manitoba

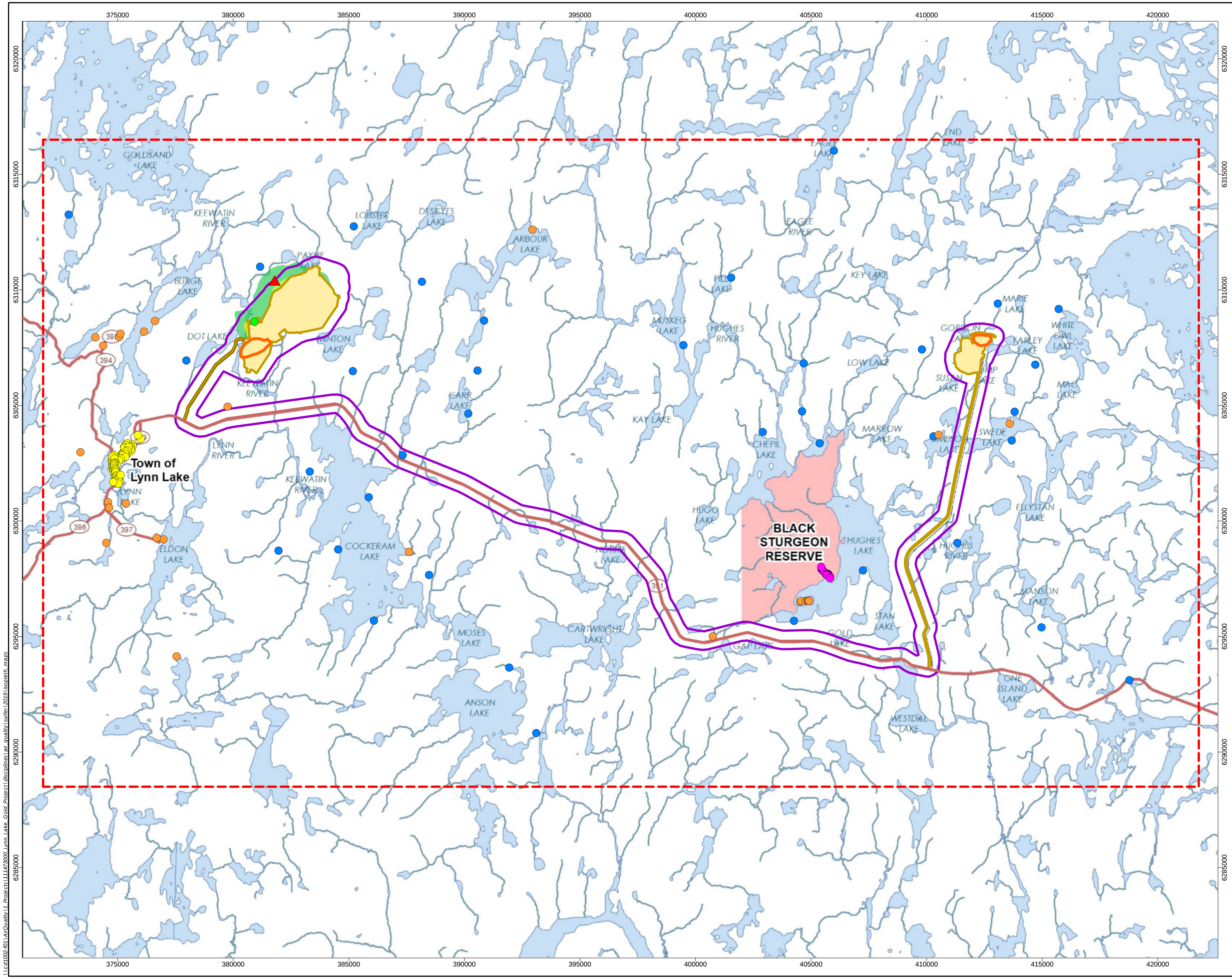
Prepared by IYankova on 2021-05-31
Technical Review by DJarratt on 2021-06-01

Client/Project 111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-115-14

Title

Maximum Predicted 24-hour Average HCN Concentrations (µg/m³) (Project Operation + Baseline Conditions)



Stantec

Alamos Gold Inc.

Study Area

- 🟧 Proposed Open Pit
- 🟨 Project Development Area
- 🟪 Project Boundary
- 🟥 Air Quality Local Assessment Area

Human Receptors

- ● Lynn Lake Receptors
- ● Black Sturgeon Reserve Receptors
- ● Human Receptors
- ● Potential Indigenous Receptor
- ● Worker Camp

Landbase

- Highway
- Access Road
- Watercourse
- Waterbody
- First Nation Reserve

Maximum Concentrations

- ● Maximum Concentration (Gordon Site): 0 µg/m³
- ▲ Maximum Concentration (MacLellan Site): 0.547 µg/m³

Background Concentration:0 µg/m³

Annual HCN MAAQC: 3 µg/m³

🟩	🟩	🟨	🟧	🟥
0.3	0.75	1.2	2.25	3

N

0 1500 3000 4500 6000 Metres

(At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

Project Location
Lynn Lake,
Manitoba

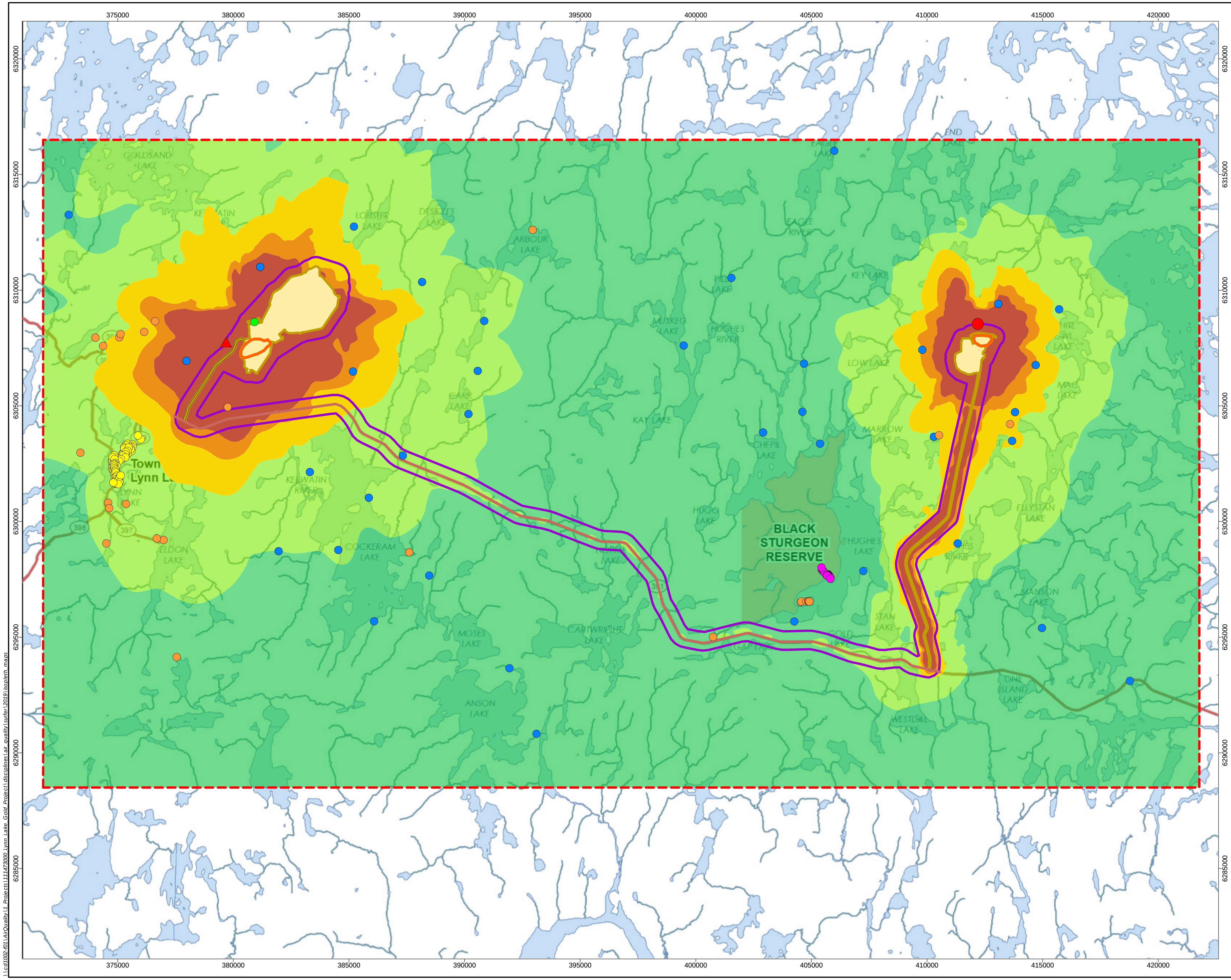
Prepared by IYankova on 2021-05-31
Technical Review by DJarratt on 2021-06-01

Client/Project 111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-115-15

Title

Maximum Predicted Annual Average HCN Concentrations (µg/m³) (Project Operation + Baseline Conditions)



Stantec

Alamos Gold Inc.

Study Area

- 🟧 Proposed Open Pit
- 🟨 Project Development Area
- 🟪 Project Boundary
- 🟥 Air Quality Local Assessment Area

Human Receptors

- ● Lynn Lake Receptors
- ● Black Sturgeon Reserve Receptors
- ● Human Receptors
- ● Potential Indigenous Receptor
- ● Worker Camp

Landbase

- Highway
- Access Road
- Watercourse
- Waterbody
- First Nation Reserve

Maximum Concentrations

- ● Maximum Concentration (Gordon Site): 606 µg/m3
- ▲ Maximum Concentration (MacLellan Site): 513 µg/m3

Background Concentration:10.5 µg/m3

24-hour TSP MAAQC: 120 µg/m3

🟩	🟩	🟨	🟧	🟥
12	30	60	90	120

N

0 1500 3000 4500 6000 Metres

(At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

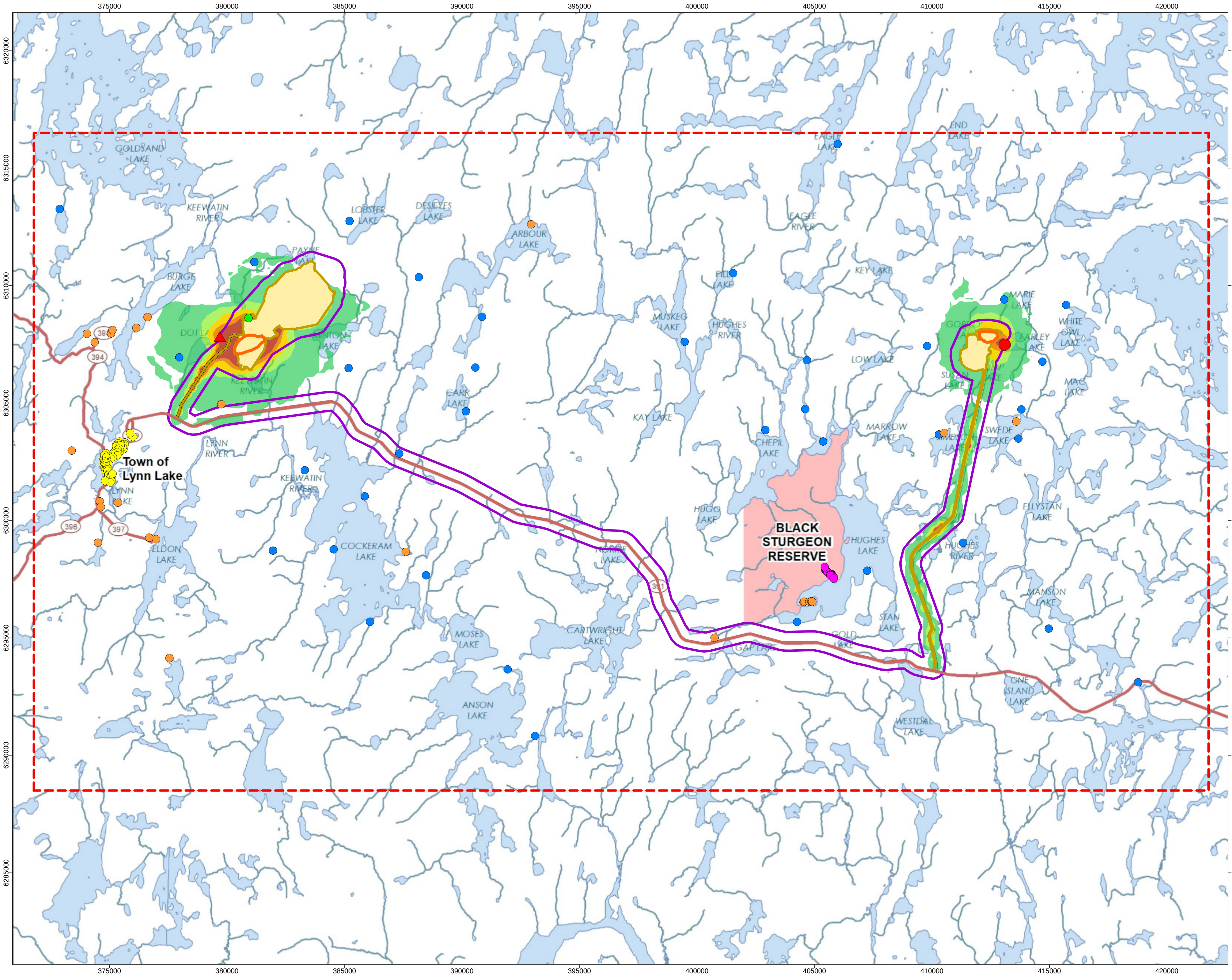
Project Location
Lynn Lake,
Manitoba

Prepared by IYankova on 2021-05-31
Technical Review by DJarratt on 2021-06-01

Client/Project 111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-115-16

Title
Maximum Predicted 24-hour Average TSP Concentrations (µg/m3) (Project Operation + Baseline Conditions)



Stantec

ALAMOS GOLD INC.

Study Area

- Proposed Open Pit
- Project Development Area
- Project Boundary
- Air Quality Local Assessment Area

Human Receptors

- Lynn Lake Receptors
- Black Sturgeon Reserve Receptors
- Human Receptors
- Potential Indigenous Receptor
- Worker Camp

Landbase

- Highway
- Access Road
- Watercourse
- Waterbody
- First Nation Reserve

Maximum Concentrations

- ● Maximum Exceedances (Gordon Site): 73 days/year
- ▲ Maximum Exceedances (MacLellan Site): 64 days/year

Background Concentration: 10.5 µg/m³

24-hour TSP MAAQC: 120 µg/m³

🟩	🟩	🟨	🟧	🟥
1	15	30	45	60

N

0 1500 3000 4500 6000 Metres

(At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

Project Location
Lynn Lake,
Manitoba

Prepared by IYankova on 2021-05-31
Technical Review by DJarratt on 2021-06-01

Client/Project 111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-115-17

Title

Maximum Frequency Exceedance of 24-hour Average Level TSP Concentrations (Project Operation + Baseline Conditions)

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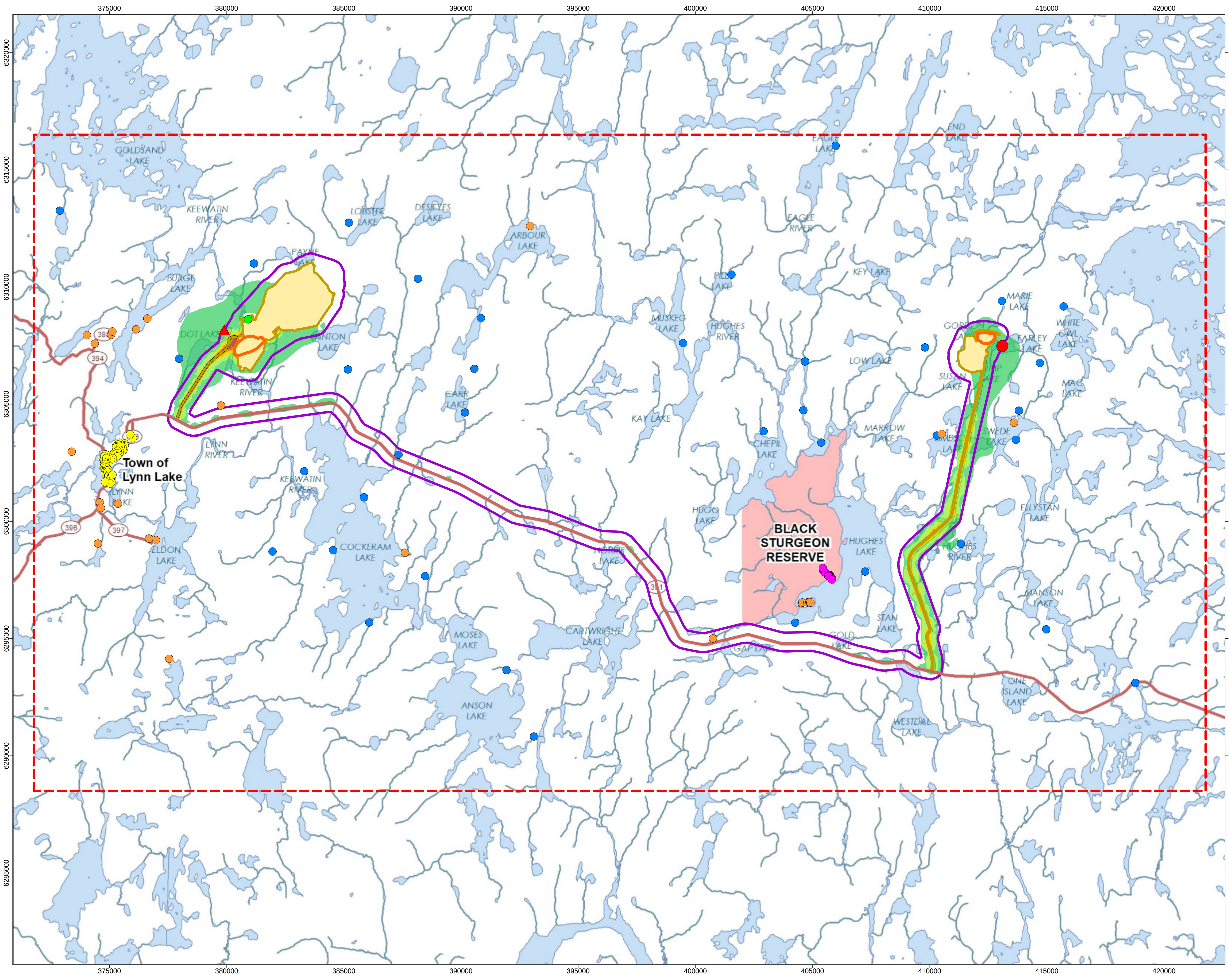

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Stantec

ALAMOS GOLD INC.

Study Area

- 🟧 Proposed Open Pit
- 🟨 Project Development Area
- 🟪 Project Boundary
- ⬚ Air Quality Local Assessment Area

Human Receptors

- ● Lynn Lake Receptors
- ● Black Sturgeon Reserve Receptors
- ● Human Receptors
- ● Potential Indigenous Receptor
- ● Worker Camp

Landbase

- — Highway
- = Access Road
- — Watercourse
- ▭ Waterbody
- ▭ First Nation Reserve

Maximum Concentrations

- ● Maximum Concentration (Gordon Site): 14.7 µg/m³
- ▲ Maximum Concentration (MacLellan Site): 14.2 µg/m³

Background Concentration:10.5 µg/m³

Annual TSP MAAQC: 60 µg/m³

🟩	🟩	🟨	🟧	🟥
12	15	30	45	60

N

0 1500 3000 4500 6000 Metres

(At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

Project Location
Lynn Lake,
Manitoba

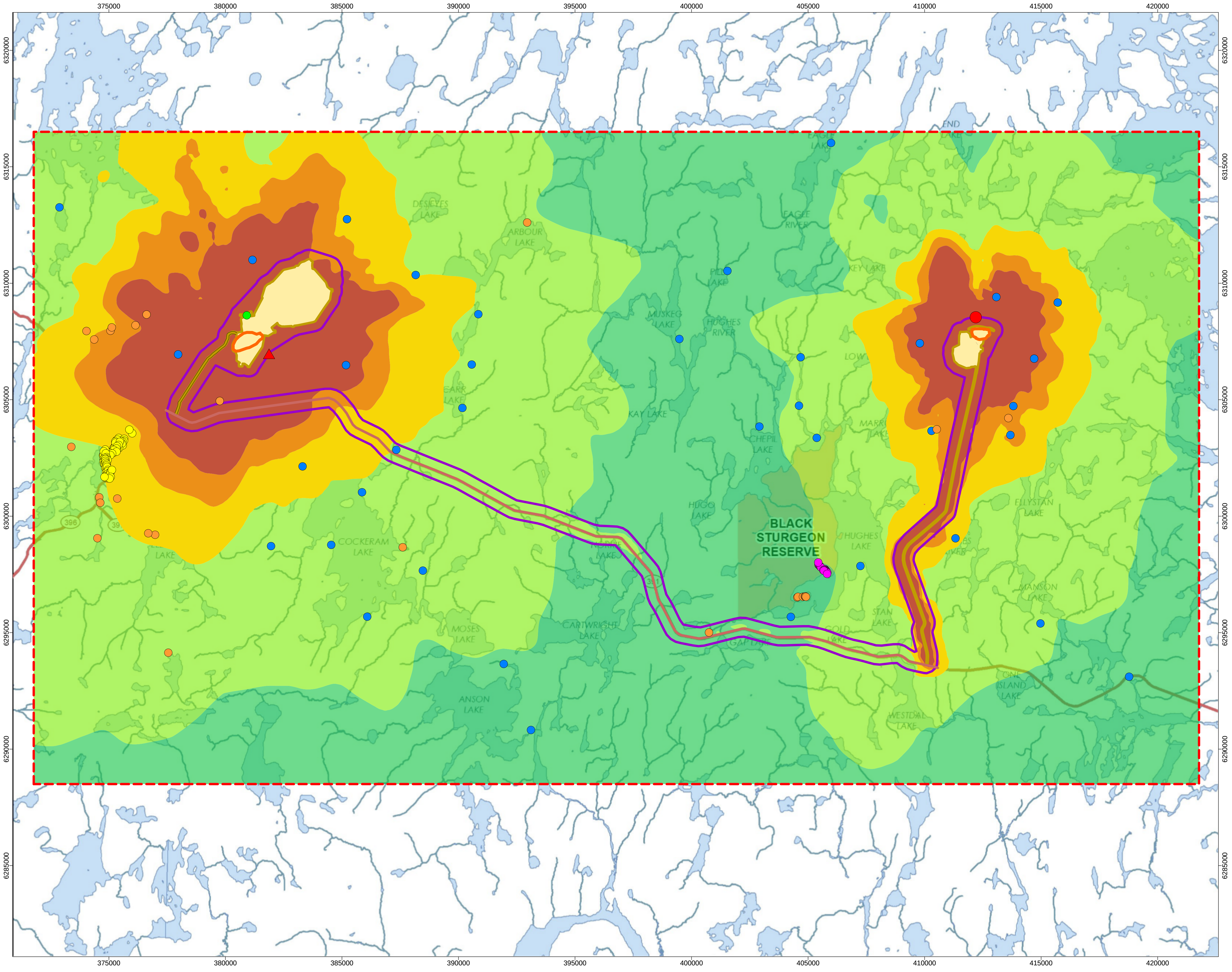
Prepared by IYankova on 2021-05-31
Technical Review by DJarratt on 2021-06-01

Client/Project
111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-115-18

Title

Maximum Predicted Annual Average TSP Concentrations (µg/m³) (Project Operation + Baseline Conditions)



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Stantec

Alamos Gold Inc.

Study Area

- 🟧 Proposed Open Pit
- 🟨 Project Development Area
- 🟪 Project Boundary
- ▭ Air Quality Local Assessment Area

Human Receptors

- ● Lynn Lake Receptors
- ● Black Sturgeon Reserve Receptors
- ● Human Receptors
- ● Potential Indigenous Receptor
- ● Worker Camp

Landbase

- Highway
- Access Road
- Watercourse
- Waterbody
- First Nation Reserve

Maximum Concentrations

- ● Maximum Concentration (Gordon Site): 361 μg/m3
- ▲ Maximum Concentration (MacLellan Site): 315 μg/m3

Background Concentration:4.6 μg/m3

24-hour PM_{10} MAAQC: 50 μg/m3

🟩	🟩	🟨	🟧	🟥
5	12.5	25	37.5	50

N

0 1500 3000 4500 6000 Metres

(At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

Project Location
Lynn Lake,
Manitoba

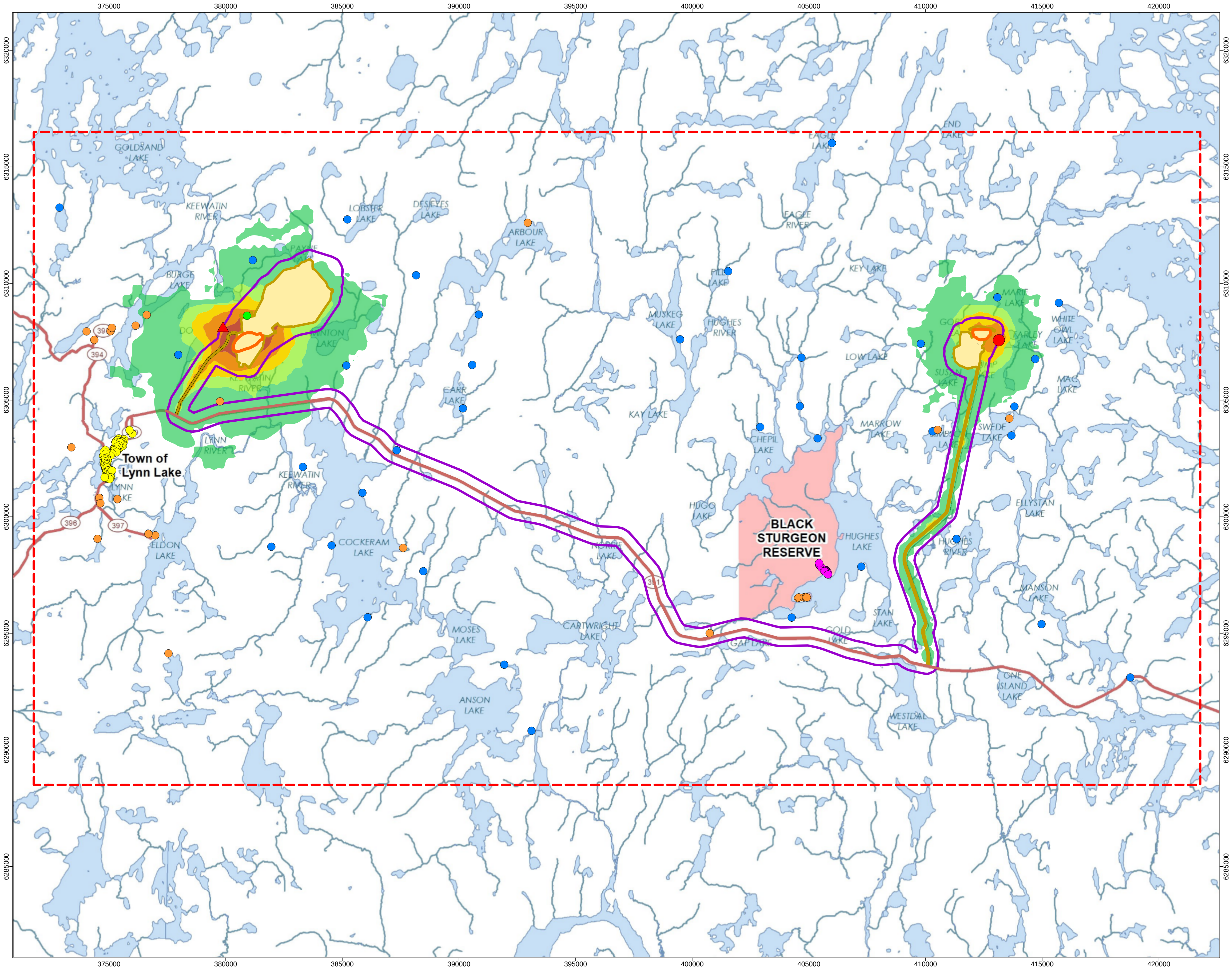
Prepared by IYankova on 2021-05-31
Technical Review by DJarratt on 2021-06-01

Client/Project 111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-115-19

Title

Maximum Predicted 24-hour Average PM_{10} Concentrations (μg/m3) (Project Operation + Baseline Conditions)



Stantec

ALAMOS GOLD INC.

Study Area

🟧 Proposed Open Pit

🟨 Project Development Area

🟪 Project Boundary

▭ Air Quality Local Assessment Area

Human Receptors

● Lynn Lake Receptors

● Black Sturgeon Reserve Receptors

● Human Receptors

● Potential Indigenous Receptor

● Worker Camp

Landbase

— Highway

═ Access Road

— Watercourse

▭ Waterbody

▭ First Nation Reserve

Maximum Concentrations

● Maximum Exceedances (Gordon Site): 110 days/year

▲ Maximum Exceedances (MacLellan Site): 89 days/year

Background Concentration: 4.6 µg/m³

24-hour PM_{10} MAAQC: 50 µg/m³

🟩	🟩	🟨	🟧	🟥

1 15 30 50 100

N

0 1500 3000 4500 6000 Metres

(At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

Project Location
Lynn Lake,
Manitoba

Prepared by IYankova on 2021-05-31
Technical Review by DJarratt on 2021-06-01

Client/Project 111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-115-20

Title

Maximum Frequency Exceedance of 24-hour Average Level PM_{10}Concentrations (Project Operation + Baseline Conditions)

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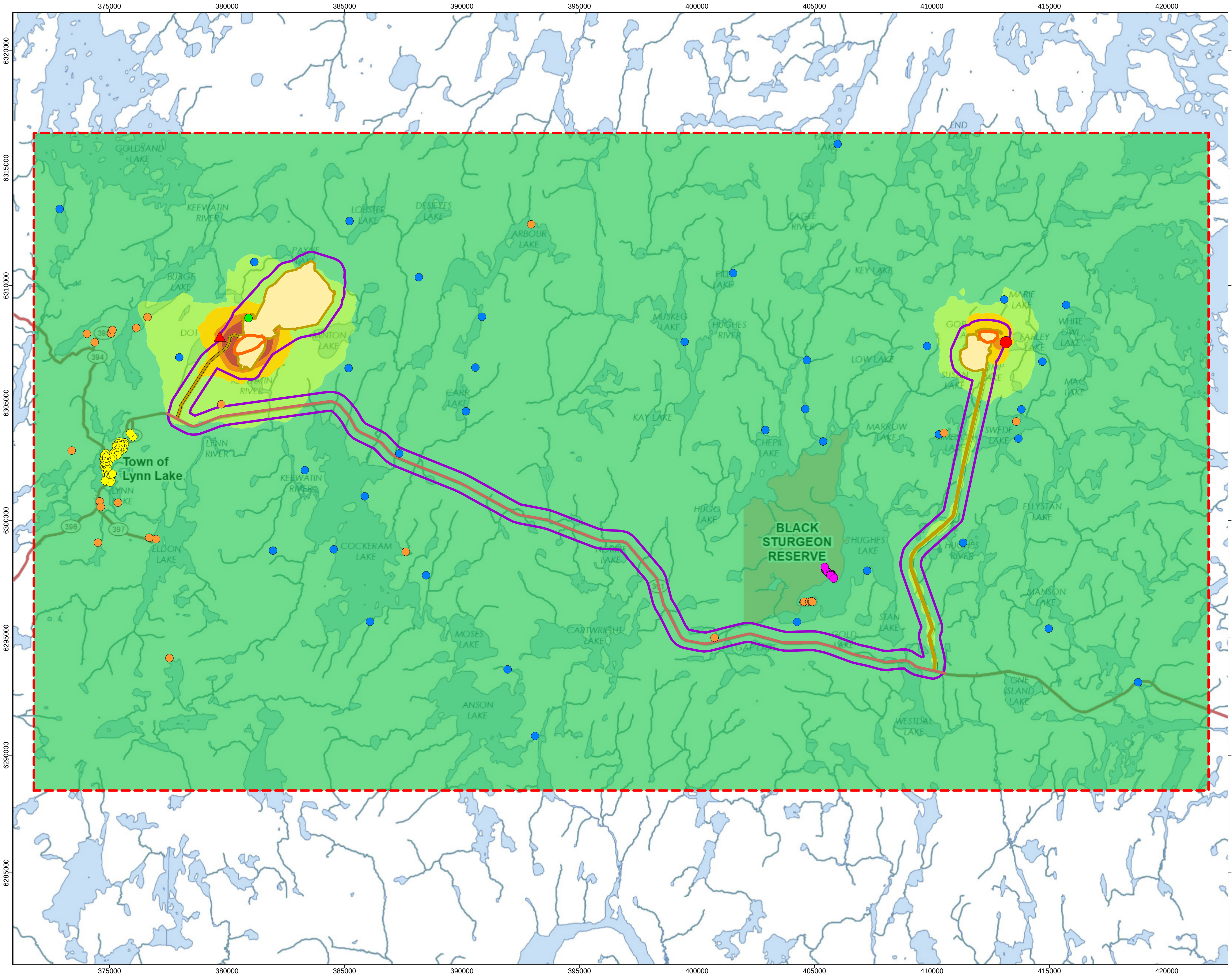

Stantec

ALAMOS GOLD INC.

Study Area

🟧 Proposed Open Pit

🟨 Project Development Area

🟪 Project Boundary

🟥 Air Quality Local Assessment Area

Human Receptors

● Lynn Lake Receptors

● Black Sturgeon Reserve Receptors

● Human Receptors

● Potential Indigenous Receptor

● Worker Camp

Landbase

— Highway

═ Access Road

— Watercourse

🟦 Waterbody

🟥 First Nation Reserve

Maximum Concentrations

● Maximum Concentration (Gordon Site): 23.5 μg/m³

▲ Maximum Concentration (MacLellan Site): 24.1 μg/m³

Background Concentration:2.9 μg/m³

24-hour $PM_{2.5}$ CAAQS: 27 μg/m³

🟩	🟩	🟨	🟧	🟥
3	6.75	13.5	20.3	27

N

0 1500 3000 4500 6000 Metres

(At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N

2. Base Data Sources: Government of Manitoba and Government of Canada

Project Location
Lynn Lake,
Manitoba

Prepared by IYankova on 2021-05-31
Technical Review by DJarratt on 2021-06-01

Client/Project 111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-115-21

Title

Maximum Predicted 98% 24-hour Average $PM_{2.5}$ Concentrations (Project Operation + Baseline Conditions)

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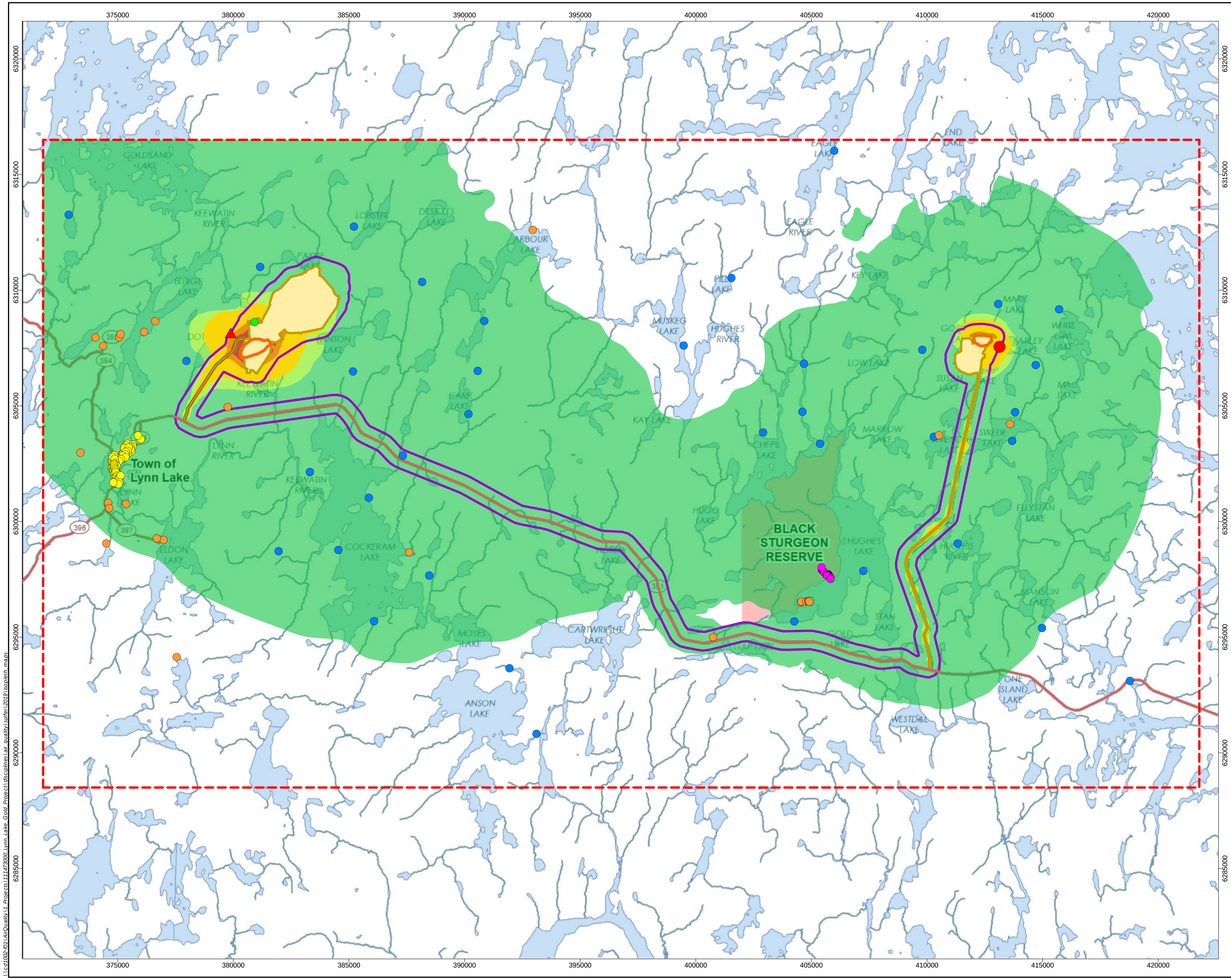


Stantec

Alamos Gold Inc.

Study Area

🟧 Proposed Open Pit

🟨 Project Development Area

🟪 Project Boundary

🟥 Air Quality Local Assessment Area

Human Receptors

● Lynn Lake Receptors

● Black Sturgeon Reserve Receptors

● Human Receptors

● Potential Indigenous Receptor

● Worker Camp

Landbase

— Highway

═ Access Road

— Watercourse

▭ Waterbody

▭ First Nation Reserve

Maximum Concentrations

● Maximum Concentration (Gordon Site): 6.87 µg/m³

▲ Maximum Concentration (MacLellan Site): 6.23 µg/m³

Background Concentration:2.9 µg/m³

Annual $PM_{2.5}$ CAAQS: 8.8 µg/m³

3 🟩 4 🟩 4.4 🟨 6.6 🟧 8.8 🟥

N

0 1500 3000 4500 6000 Metres

(At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N

2. Base Data Sources: Government of Manitoba and Government of Canada

Project Location
Lynn Lake,
Manitoba

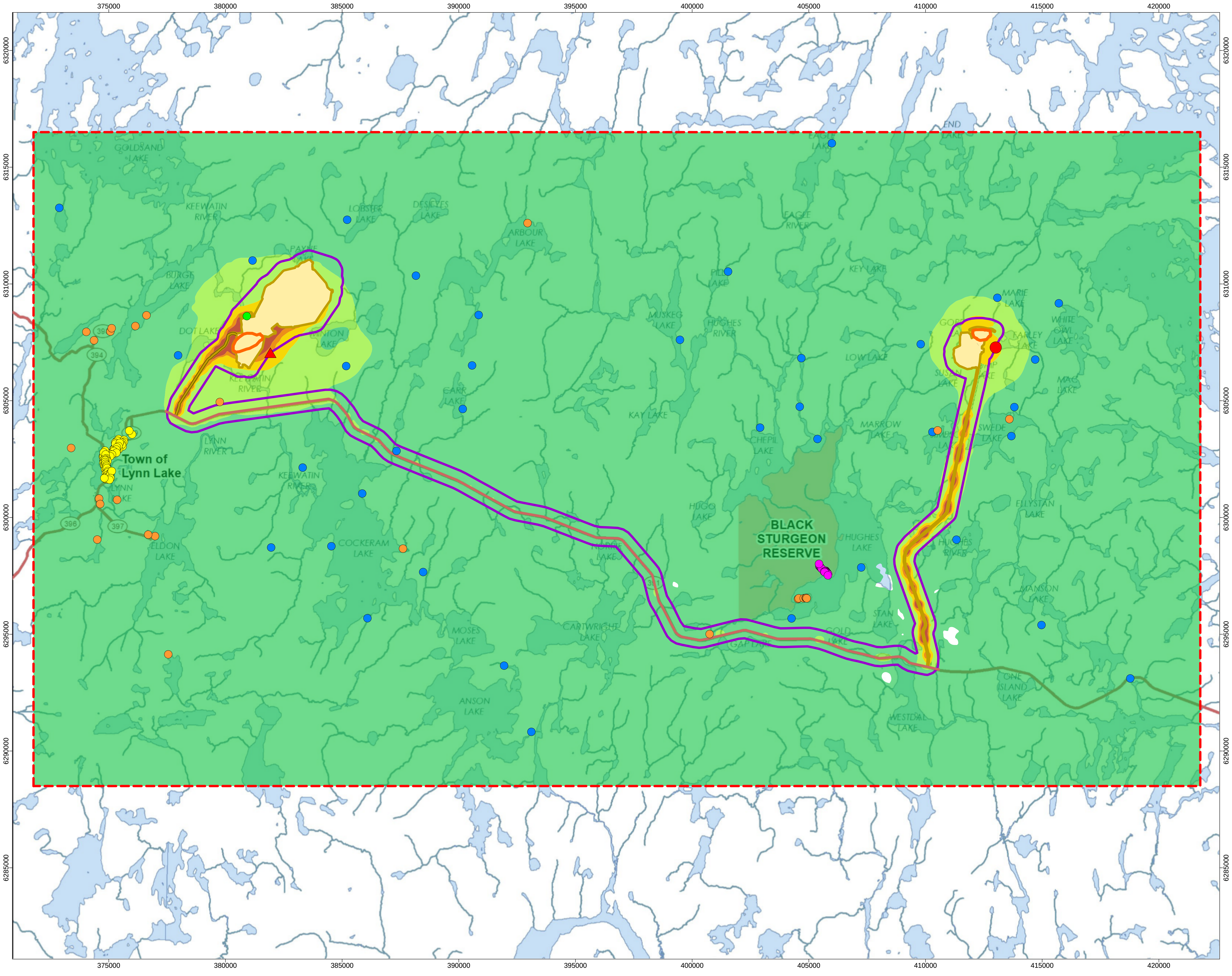
Prepared by IYankova on 2021-05-31
Technical Review by DJarratt on 2021-06-01

Client/Project 111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-115-22

Title

Maximum Predicted Annual Average $PM_{2.5}$ Concentrations (µg/m³) (Project Operation + Baseline Conditions)



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Stantec

Alamos Gold Inc.

Study Area

- 🟧 Proposed Open Pit
- 🟨 Project Development Area
- 🟪 Project Boundary
- ⬚ Air Quality Local Assessment Area

Human Receptors

- ● Lynn Lake Receptors
- ● Black Sturgeon Reserve Receptors
- ● Human Receptors
- ● Potential Indigenous Receptor
- ● Worker Camp

Landbase

- — Highway
- = Access Road
- — Watercourse
- 🟦 Waterbody
- 🟥 First Nation Reserve

Maximum Concentrations

- ● Maximum Deposition (Gordon Site): 4.90 g/m²/30-day
- ▲ Maximum Deposition (MacLellan Site): 5.51 g/m²/30-day

Background Deposition: 0.99 g/m²/30-day

30-day Dustfall OAAQC: 7 g/m²/30-day

1 1.75 3.5 5.25 7

N

0 1500 3000 4500 6000 Metres

(At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

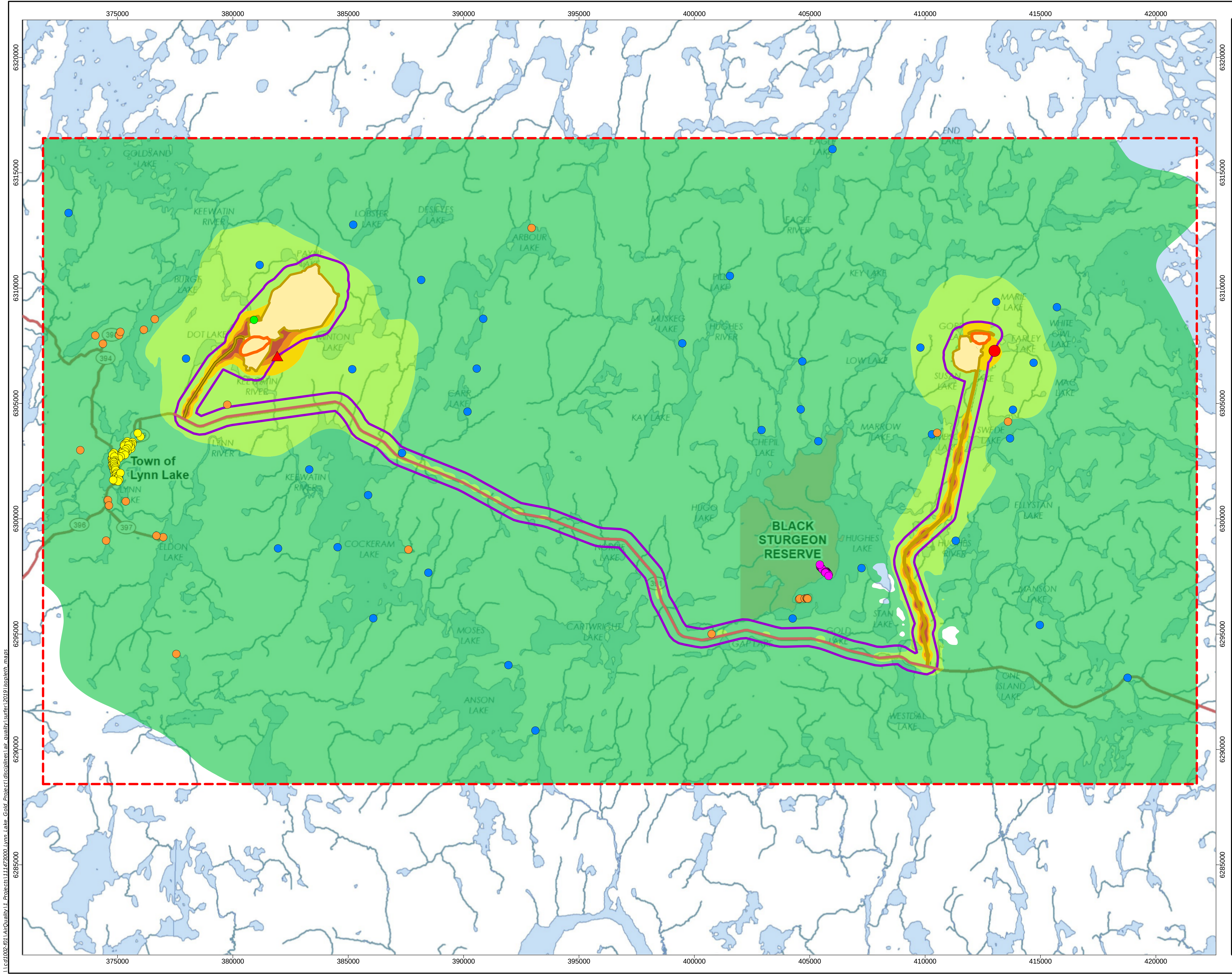
Project Location
Lynn Lake,
Manitoba

Prepared by IYankova on 2021-05-31
Technical Review by DJarratt on 2021-06-01

Client/Project 111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-115-23

Title
Maximum Predicted 30-day Average Dustfall Depositions (g/m²/30-day) (Project Operation + Baseline Conditions)



Stantec

ALAMOS GOLD INC.

Study Area

- 🟧 Proposed Open Pit
- 🟨 Project Development Area
- 🟪 Project Boundary
- 🟥 Air Quality Local Assessment Area

Human Receptors

- ● Lynn Lake Receptors
- ● Black Sturgeon Reserve Receptors
- ● Human Receptors
- ● Potential Indigenous Receptor
- ● Worker Camp

Landbase

- — Highway
- = Access Road
- — Watercourse
- 🟦 Waterbody
- 🟥 First Nation Reserve

Maximum Concentrations

- ● Maximum Deposition (Gordon Site): 3.32 g/m²/30-day
- ▲ Maximum Deposition (MacLellan Site): 3.84 g/m²/30-day

Background Deposition: 0.99 g/m²/30-day

Annual Dustfall OAAQC: 4.6 g/m²/30-day

🟩	🟩	🟨	🟧	🟥
1	1.15	2.3	3.45	4.6

N

0 1500 3000 4500 6000 Metres

(At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N

2. Base Data Sources: Government of Manitoba and Government of Canada

Project Location
Lynn Lake,
Manitoba

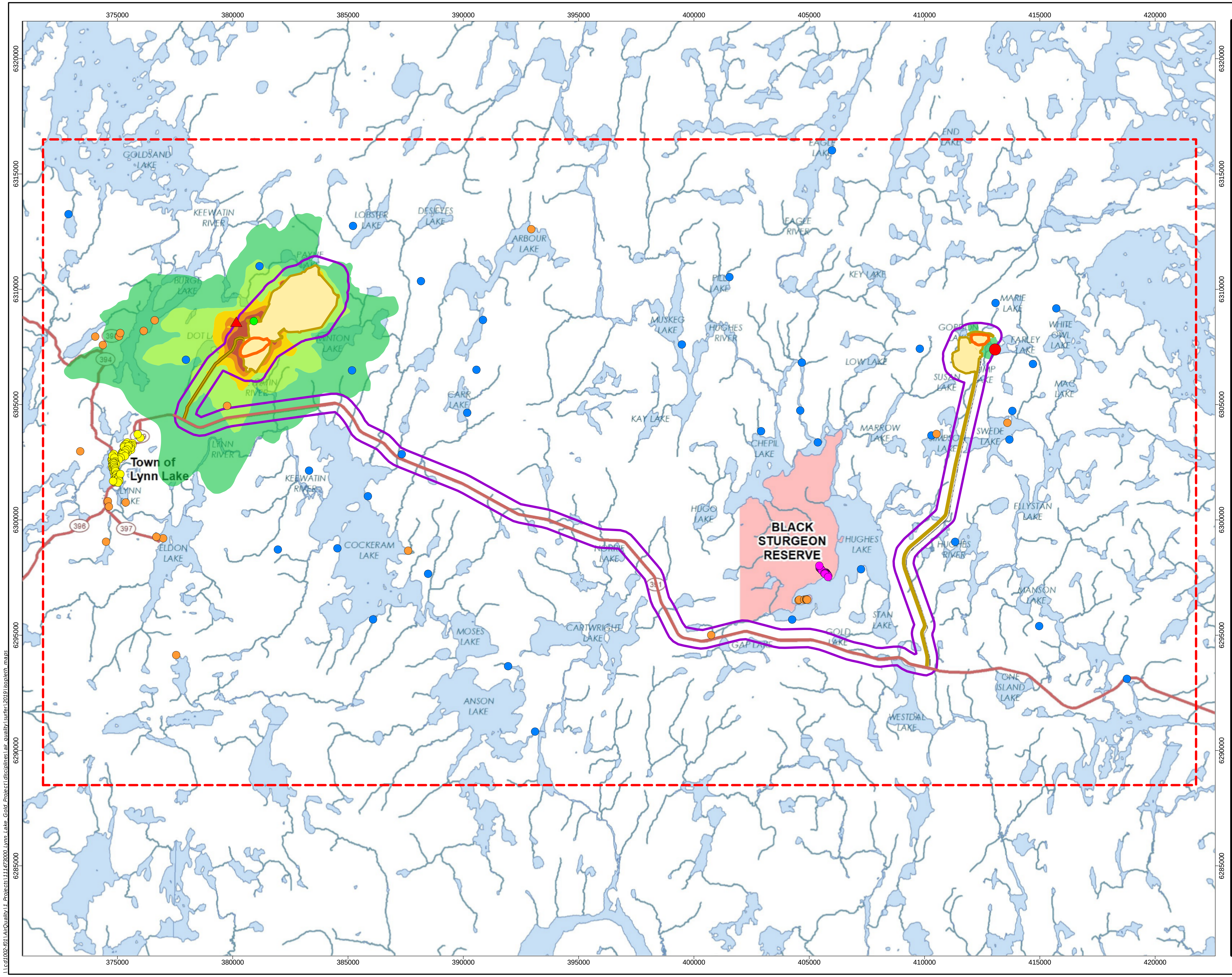
Prepared by IYankova on 2021-05-31
Technical Review by DJarratt on 2021-06-01

Client/Project 111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-115-24

Title

Maximum Predicted Annual Average Dustfall Depositions (g/m^2/30-day) (Project Operation + Baseline Conditions)



Stantec

Alamos Gold Inc.

Study Area

- 🟧 Proposed Open Pit
- 🟨 Project Development Area
- 🟪 Project Boundary
- 🟥 Air Quality Local Assessment Area

Human Receptors

- ● Lynn Lake Receptors
- ● Black Sturgeon Reserve Receptors
- ● Human Receptors
- ● Potential Indigenous Receptor
- ● Worker Camp

Landbase

- Highway
- Access Road
- Watercourse
- Waterbody
- First Nation Reserve

Maximum Concentrations

- ● Maximum Concentration (Gordon Site): 0.0379 μg/m³
- ▲ Maximum Concentration (MacLellan Site): 0.278 μg/m³

Background Concentration:0 μg/m³

24-hour Arsenic MAAQC: 0.3 μg/m³

0.03 0.075 0.15 0.225 0.3

N

0 1500 3000 4500 6000 Metres

(At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

Project Location
Lynn Lake,
Manitoba

Prepared by IYankova on 2021-05-31
Technical Review by DJarratt on 2021-06-01

Client/Project
111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-115-25

Title

Maximum Predicted 24-hour Average Arsenic Concentrations (μg/m³) (Project Operation + Baseline Conditions)

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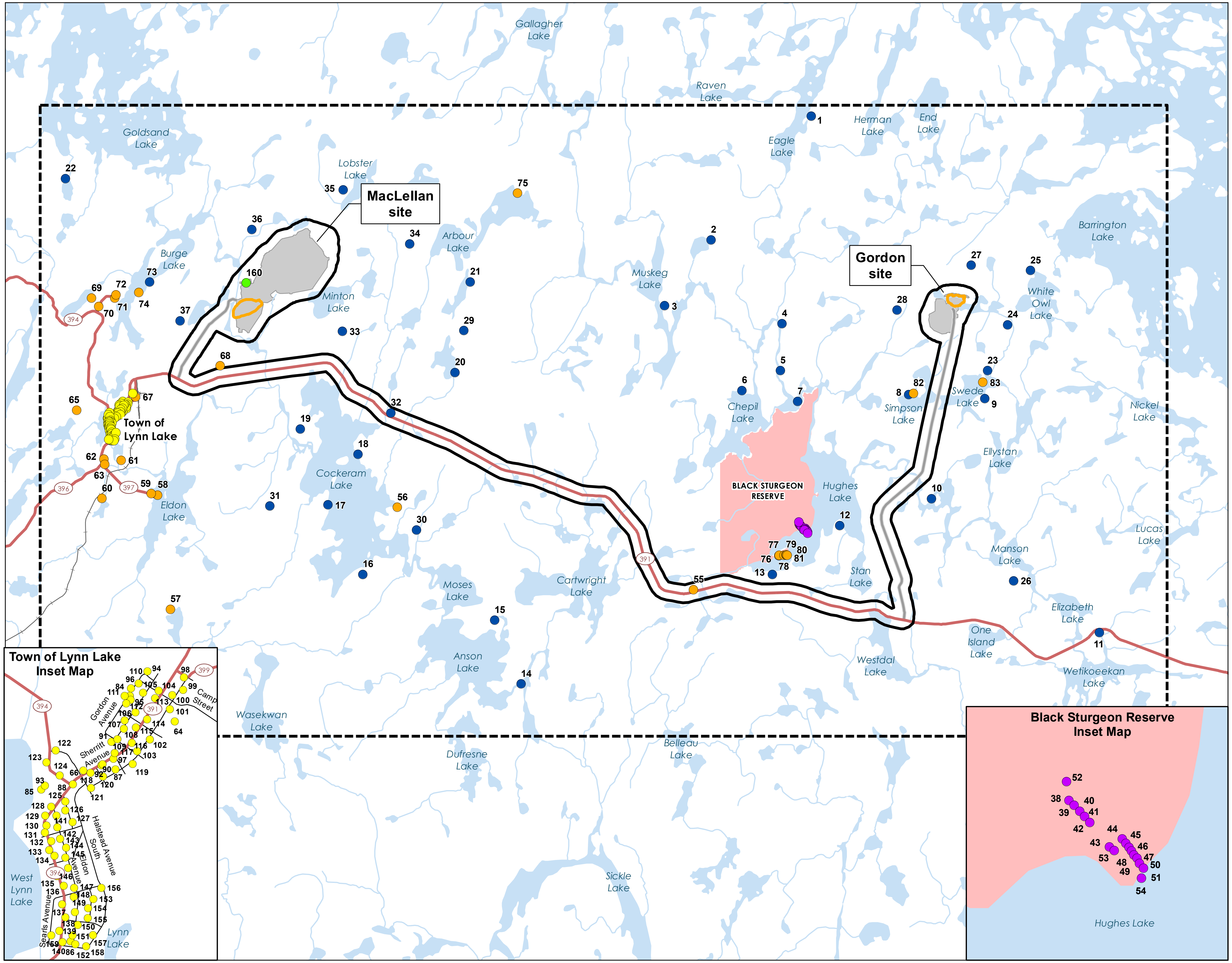

Stantec

Project Infrastructure
- ▭ Proposed Open Pit
- ▨ Project Development Area

Study Area
- ▭ Project Boundary
- ⬚ Air Quality Local Assessment Area (LAA)

Human Receptors
- ● Lynn Lake Receptors
- ● Black Sturgeon Reserve Receptors
- ● Human Receptors
- ● Potential Indigenous Receptor
- ● Worker Camp

Landbase
- — Highway
- — Access Road
- —+— Rail
- — Watercourse
- ▨ Waterbody
- ▨ First Nation Reserve

N

0 3 6 Kilometres

(At original document size of 11x17)
1:175,000

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

Project Location
Lynn Lake,
Manitoba

Prepared by ACampigotto on 2021-06-01
Technical Review by IYankova on 2021-06-01

Client/Project 111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-115-26

Title
Air Quality Local Assessment Area and Human Receptor Locations

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Table IAAC-115-1 Special Receptors

Receptor ID	Model ID	Receptor Description	Receptor Category	UTM Easting (m)	UTM Northing (m)
1	15878	Potential Indigenous Receptor 1	Potential Indigenous Receptor	405,987	6,316,024
2	15879	Potential Indigenous Receptor 2	Potential Indigenous Receptor	401,539	6,310,530
3	15880	Potential Indigenous Receptor 3	Potential Indigenous Receptor	399,477	6,307,607
4	15881	Potential Indigenous Receptor 4	Potential Indigenous Receptor	404,680	6,306,824
5	15882	Potential Indigenous Receptor 5	Potential Indigenous Receptor	404,610	6,304,744
6	15883	Potential Indigenous Receptor 6	Potential Indigenous Receptor	402,911	6,303,848
7	15884	Potential Indigenous Receptor 7	Potential Indigenous Receptor	405,371	6,303,362
8	15885	Potential Indigenous Receptor 8	Potential Indigenous Receptor	410,297	6,303,663
9	15886	Potential Indigenous Receptor 9	Potential Indigenous Receptor	413,681	6,303,484
10	15887	Potential Indigenous Receptor 10	Potential Indigenous Receptor	411,326	6,299,050
11	15888	Potential Indigenous Receptor 11	Potential Indigenous Receptor	418,775	6,293,108
12	15889	Potential Indigenous Receptor 12	Potential Indigenous Receptor	407,246	6,297,860
13	15890	Potential Indigenous Receptor 13	Potential Indigenous Receptor	404,260	6,295,677
14	15891	Potential Indigenous Receptor 14	Potential Indigenous Receptor	393,110	6,290,821
15	15892	Potential Indigenous Receptor 15	Potential Indigenous Receptor	391,941	6,293,656
16	15893	Potential Indigenous Receptor 16	Potential Indigenous Receptor	386,085	6,295,686
17	15894	Potential Indigenous Receptor 17	Potential Indigenous Receptor	384,540	6,298,769
18	15895	Potential Indigenous Receptor 18	Potential Indigenous Receptor	385,862	6,301,026
19	15896	Potential Indigenous Receptor 19	Potential Indigenous Receptor	383,310	6,302,138
20	15897	Potential Indigenous Receptor 20	Potential Indigenous Receptor	390,169	6,304,646
21	15898	Potential Indigenous Receptor 21	Potential Indigenous Receptor	390,852	6,308,671
22	15899	Potential Indigenous Receptor 22	Potential Indigenous Receptor	372,879	6,313,259
23	15900	Potential Indigenous Receptor 23	Potential Indigenous Receptor	413,807	6,304,728
24	15901	Potential Indigenous Receptor 24	Potential Indigenous Receptor	414,701	6,306,764

Table IAAC-115-1 Special Receptors

Receptor ID	Model ID	Receptor Description	Receptor Category	UTM Easting (m)	UTM Northing (m)
25	15902	Potential Indigenous Receptor 25	Potential Indigenous Receptor	415,713	6,309,172
26	15903	Potential Indigenous Receptor 26	Potential Indigenous Receptor	414,971	6,295,396
27	15904	Potential Indigenous Receptor 27	Potential Indigenous Receptor	413,079	6,309,406
28	15905	Potential Indigenous Receptor 28	Potential Indigenous Receptor	409,795	6,307,422
29	15906	Potential Indigenous Receptor 29	Potential Indigenous Receptor	390,569	6,306,510
30	15907	Potential Indigenous Receptor 30	Potential Indigenous Receptor	388,472	6,297,664
31	15908	Potential Indigenous Receptor 31	Potential Indigenous Receptor	381,958	6,298,715
32	15909	Potential Indigenous Receptor 32	Potential Indigenous Receptor	387,332	6,302,851
33	15910	Potential Indigenous Receptor 33	Potential Indigenous Receptor	385,174	6,306,484
34	15911	Potential Indigenous Receptor 34	Potential Indigenous Receptor	388,163	6,310,354
35	15912	Potential Indigenous Receptor 35	Potential Indigenous Receptor	385,216	6,312,749
36	15913	Potential Indigenous Receptor 36	Potential Indigenous Receptor	381,162	6,311,003
37	15914	Potential Indigenous Receptor 37	Potential Indigenous Receptor	377,971	6,306,944
38	15915	Black Sturgeon Reserve Residence 1	Black Sturgeon Reserve	405,449	6,297,916
39	15916	Black Sturgeon Reserve Residence 2	Black Sturgeon Reserve	405,476	6,297,893
40	15917	Black Sturgeon Reserve Residence 3	Black Sturgeon Reserve	405,503	6,297,862
41	15918	Black Sturgeon Reserve Residence 4	Black Sturgeon Reserve	405,527	6,297,835
42	15919	Black Sturgeon Reserve Residence 5	Black Sturgeon Reserve	405,554	6,297,805
43	15920	Black Sturgeon Reserve Residence 6	Black Sturgeon Reserve	405,654	6,297,681
44	15921	Black Sturgeon Reserve Residence 7	Black Sturgeon Reserve	405,720	6,297,721
45	15922	Black Sturgeon Reserve Residence 8	Black Sturgeon Reserve	405,738	6,297,699
46	15923	Black Sturgeon Reserve Residence 9	Black Sturgeon Reserve	405,753	6,297,679
47	15924	Black Sturgeon Reserve Residence 10	Black Sturgeon Reserve	405,765	6,297,661
48	15925	Black Sturgeon Reserve Residence 11	Black Sturgeon Reserve	405,778	6,297,640

Table IAAC-115-1 Special Receptors

Receptor ID	Model ID	Receptor Description	Receptor Category	UTM Easting (m)	UTM Northing (m)
49	15926	Black Sturgeon Reserve Residence 12	Black Sturgeon Reserve	405,794	6,297,624
50	15927	Black Sturgeon Reserve Residence 13	Black Sturgeon Reserve	405,807	6,297,597
51	15928	Black Sturgeon Reserve Residence 14	Black Sturgeon Reserve	405,827	6,297,574
52	15929	Black Sturgeon Reserve Infrastructure	Black Sturgeon Reserve	405,437	6,298,013
53	15930	Black Sturgeon Reserve Potential Residence 1	Black Sturgeon Reserve	405,679	6,297,662
54	15931	Black Sturgeon Reserve Potential Residence 2	Black Sturgeon Reserve	405,817	6,297,522
55	15932	Remote Cottage	Human Receptors	400,748	6,295,006
56	15933	Remote Cottage	Human Receptors	387,607	6,298,666
57	15934	Remote Cottage	Human Receptors	377,549	6,294,140
58	15935	Float Plane	Human Receptors	376,983	6,299,203
59	15936	Admin Site	Human Receptors	376,689	6,299,267
60	15937	Fish Farm	Human Receptors	374,507	6,299,055
61	15938	Lagoon	Human Receptors	375,360	6,300,756
62	15939	Warehouse Site	Human Receptors	374,586	6,300,811
63	15940	Highway Maintenance Yard	Human Receptors	374,631	6,300,577
64	15941	Recreation Site	Human Receptors	375,594	6,303,042
65	15942	Dog Kennel	Human Receptors	373,388	6,302,976
66	15943	Museum Site	Human Receptors	375,014	6,302,733
67	15944	Communication Site	Human Receptors	376,000	6,303,559
68	15945	Waste Disposal Site	Human Receptors	379,757	6,304,945
69	15946	Remote Cottage	Human Receptors	374,038	6,307,949
70	15947	Riding Stable	Human Receptors	374,369	6,307,586

Table IAAC-115-1 Special Receptors

Receptor ID	Model ID	Receptor Description	Receptor Category	UTM Easting (m)	UTM Northing (m)
71	15948	Recreation Lot	Human Receptors	375,069	6,307,961
72	15949	Recreation Lot	Human Receptors	375,124	6,308,104
73	15951	Potential Indigenous Receptor 38	Potential Indigenous Receptor	376,617	6,308,656
74	15984	Remote Cottage	Human Receptors	376,126	6,308,197
75	15952	Trapper Cabin	Human Receptors	392,947	6,312,606
76	15953	Recreation Lot	Human Receptors	404,536	6,296,516
77	15954	Recreation Lot	Human Receptors	404,567	6,296,540
78	15955	Remote Cottage	Human Receptors	404,780	6,296,541
79	15956	Remote Cottage	Human Receptors	404,865	6,296,554
80	15957	Remote Cottage	Human Receptors	404,882	6,296,557
81	15958	Remote Cottage	Human Receptors	404,909	6,296,538
82	15959	Remote Cottage	Human Receptors	410,520	6,303,729
83	15960	Trapper Cabin	Human Receptors	413,593	6,304,211
84	15991	Lynn Lake Friendship Centre	Lynn Lake Receptors	375,309	6,303,206
85	15992	Marcel Colomb First Nation Centre	Lynn Lake Receptors	374,748	6,302,611
86	15993	St. Simon's Church	Lynn Lake Receptors	374,934	6,301,646
87	15994	Lynn Lake Gospel Church	Lynn Lake Receptors	375,219	6,302,737
88	15995	St. Maria Goretti Catholic Church	Lynn Lake Receptors	374,949	6,302,645
89	15996	Misc. Commercial	Lynn Lake Receptors	375,877	6,303,715
90	15997	Lynn Lake Library	Lynn Lake Receptors	375,129	6,302,767
91	15998	Royal Canadian Mounted Police (RCMP)	Lynn Lake Receptors	375,194	6,302,913
92	15999	Town of Lynn Lake	Lynn Lake Receptors	375,137	6,302,770
93	16000	West Lynn Lake Heights School	Lynn Lake Receptors	374,770	6,302,635
94	16001	Lynn Lake Hospital	Lynn Lake Receptors	375,423	6,303,359

Table IAAC-115-1 Special Receptors

Receptor ID	Model ID	Receptor Description	Receptor Category	UTM Easting (m)	UTM Northing (m)
95	16002	Addictions Foundation-Manitoba	Lynn Lake Receptors	375,290	6,303,212
96	16003	The Bronx	Lynn Lake Receptors	375,318	6,303,254
97	16004	Lynn Lake Inn	Lynn Lake Receptors	375,188	6,302,784
98	16005	Residential 1 - Halstead Ave.	Lynn Lake Receptors	375,653	6,303,322
99	16006	Residential 2 - Halstead Ave.	Lynn Lake Receptors	375,648	6,303,244
100	16007	Residential 3 - Halstead Ave.	Lynn Lake Receptors	375,580	6,303,211
101	16008	Residential 4 - Halstead Ave.	Lynn Lake Receptors	375,564	6,303,122
102	16009	Residential 5 - Halstead Ave.	Lynn Lake Receptors	375,436	6,302,927
103	16010	Residential 6 - Halstead Ave.	Lynn Lake Receptors	375,356	6,302,854
104	16011	Residential 7 - Camp St.	Lynn Lake Receptors	375,492	6,303,237
105	16012	Residential 8 - Hales Ave.	Lynn Lake Receptors	375,395	6,303,225
106	16013	Residential 9 - Hales Ave.	Lynn Lake Receptors	375,345	6,303,102
107	16014	Residential 10 - Hales Ave.	Lynn Lake Receptors	375,278	6,303,050
108	16015	Residential 11 - Hales Ave.	Lynn Lake Receptors	375,273	6,302,997
109	16016	Residential 12 - Hales Ave.	Lynn Lake Receptors	375,232	6,302,932
110	16017	Residential 13 - Gordon Ave.	Lynn Lake Receptors	375,365	6,303,284
111	16018	Residential 14 - Gordon Ave.	Lynn Lake Receptors	375,277	6,303,205
112	16019	Residential 15 - Gordon Ave.	Lynn Lake Receptors	375,286	6,303,158
113	16020	Residential 16 - Highway 391	Lynn Lake Receptors	375,469	6,303,189
114	16021	Residential 17 - Highway 391	Lynn Lake Receptors	375,419	6,303,055
115	16022	Residential 18 - Highway 391	Lynn Lake Receptors	375,347	6,303,003
116	16023	Residential 19 - Highway 391	Lynn Lake Receptors	375,322	6,302,909
117	16024	Residential 20 - Highway 391	Lynn Lake Receptors	375,213	6,302,842
118	16025	Residential 21 - Highway 391	Lynn Lake Receptors	375,062	6,302,716

Table IAAC-115-1 Special Receptors

Receptor ID	Model ID	Receptor Description	Receptor Category	UTM Easting (m)	UTM Northing (m)
119	16026	Residential 22 - Halstead Ave.	Lynn Lake Receptors	375,328	6,302,773
120	16027	Residential 23 - Halstead Ave.	Lynn Lake Receptors	375,140	6,302,694
121	16028	Residential 24 - Halstead Ave.	Lynn Lake Receptors	375,064	6,302,622
122	16029	Residential 25 - Cobalt Pl	Lynn Lake Receptors	374,840	6,302,860
123	16030	Residential 26 - Silver St.	Lynn Lake Receptors	374,781	6,302,784
124	16031	Residential 27 - Silver St.	Lynn Lake Receptors	374,865	6,302,699
125	16032	Residential 28 - McVeigh Ave.	Lynn Lake Receptors	374,902	6,302,535
126	16033	Residential 29 - McVeigh Ave.	Lynn Lake Receptors	374,901	6,302,479
127	16034	Residential 30 - McVeigh Ave.	Lynn Lake Receptors	374,946	6,302,404
128	16035	Residential 31 - Sherritt Ave.	Lynn Lake Receptors	374,812	6,302,500
129	16036	Residential 32 - Sherritt Ave.	Lynn Lake Receptors	374,774	6,302,444
130	16037	Residential 33 - Sherritt Ave.	Lynn Lake Receptors	374,781	6,302,380
131	16038	Residential 34 - Sherritt Ave.	Lynn Lake Receptors	374,771	6,302,337
132	16039	Residential 35 - Sherritt Ave.	Lynn Lake Receptors	374,811	6,302,283
133	16040	Residential 36 - Sherritt Ave.	Lynn Lake Receptors	374,799	6,302,228
134	16041	Residential 37 - Sherritt Ave.	Lynn Lake Receptors	374,832	6,302,191
135	16042	Residential 38 - Sherritt Ave.	Lynn Lake Receptors	374,847	6,302,061
136	16043	Residential 39 - Sherritt Ave.	Lynn Lake Receptors	374,891	6,302,000
137	16044	Residential 40 - Sherritt Ave.	Lynn Lake Receptors	374,880	6,301,883
138	16045	Residential 41 - Sherritt Ave.	Lynn Lake Receptors	374,901	6,301,799
139	16046	Residential 42 - Sherritt Ave.	Lynn Lake Receptors	374,862	6,301,713
140	16047	Residential 43 - Sherritt Ave.	Lynn Lake Receptors	374,884	6,301,642
141	16048	Residential 44 - Edmon Ave.	Lynn Lake Receptors	374,846	6,302,446
142	16049	Residential 45 - Edmon Ave.	Lynn Lake Receptors	374,849	6,302,371

Table IAAC-115-1 Special Receptors

Receptor ID	Model ID	Receptor Description	Receptor Category	UTM Easting (m)	UTM Northing (m)
143	16050	Residential 46 - Edmon Ave.	Lynn Lake Receptors	374,867	6,302,297
144	16051	Residential 47 - Edmon Ave.	Lynn Lake Receptors	374,906	6,302,243
145	16052	Residential 48 - Edmon Ave.	Lynn Lake Receptors	374,901	6,302,177
146	16053	Residential 49 - Edmon Ave.	Lynn Lake Receptors	374,918	6,302,113
147	16054	Residential 50 - Edmon Ave.	Lynn Lake Receptors	374,958	6,301,988
148	16055	Residential 51 - Edmon Ave.	Lynn Lake Receptors	374,953	6,301,931
149	16056	Residential 52 - Edmon Ave.	Lynn Lake Receptors	374,963	6,301,833
150	16057	Residential 53 - Edmon Ave.	Lynn Lake Receptors	374,980	6,301,752
151	16058	Residential 54 - Edmon Ave.	Lynn Lake Receptors	374,947	6,301,686
152	16059	Residential 55 - Edmon Ave.	Lynn Lake Receptors	374,964	6,301,630
153	16060	Residential 56 - McVeigh Ave. S.	Lynn Lake Receptors	375,078	6,301,916
154	16061	Residential 57 - McVeigh Ave. S.	Lynn Lake Receptors	375,047	6,301,857
155	16062	Residential 58 - McVeigh Ave. S.	Lynn Lake Receptors	375,043	6,301,793
156	16063	Residential 59 - Halstead Ave. S.	Lynn Lake Receptors	375,129	6,301,986
157	16064	Residential 60 - Halstead Ave. S.	Lynn Lake Receptors	375,077	6,301,688
158	16065	Residential 61 - Zinc St.	Lynn Lake Receptors	375,032	6,301,617
159	16066	Residential 62 - Zinc St.	Lynn Lake Receptors	374,812	6,301,685
160	16070	Permanent Work Camp	Work Camp	380,916	6,308,622

Table IAAC-115-2 Predicted Maximum Ground-level Concentrations at Special Receptors from Project Operation (µg/m³) (including Baseline Conditions)

Receptor ID	Model ID	Receptor Description	UTM Zone 14 NAD 83		NO_2		SO_2		HCN		$PM_{2.5}$		DPM	
			Easting (m)	Northing (m)	1-hour [b]	Annual [c]	1-hour [d]	24-hour [e]	1-hour [f]	Annual	24-hour [g]	Annual [h]	2-hour	Annual
			AAQC [a]		79 [i]	23 [i]	170 [i]	150	40	3	27 [i]	8.8 [i]	10 [j]	5 [j]
1	15878	Potential Indigenous Receptor 1	405,987	6,316,024	19.48	2.11	8.01	6.40	0.21	0.003	3.25	2.96	0.14	0.002
2	15879	Potential Indigenous Receptor 2	401,539	6,310,530	20.40	2.16	8.27	6.38	0.31	0.006	3.30	2.98	0.16	0.003
3	15880	Potential Indigenous Receptor 3	399,477	6,307,607	21.41	2.20	8.31	6.37	0.48	0.008	3.39	2.99	0.15	0.003
4	15881	Potential Indigenous Receptor 4	404,680	6,306,824	30.83	2.29	10.28	6.81	0.30	0.005	3.49	3.01	0.28	0.004
5	15882	Potential Indigenous Receptor 5	404,610	6,304,744	26.92	2.24	9.24	6.77	0.25	0.006	3.49	3.01	0.24	0.004
6	15883	Potential Indigenous Receptor 6	402,911	6,303,848	25.45	2.21	8.55	6.56	0.32	0.007	3.42	3.01	0.18	0.004
7	15884	Potential Indigenous Receptor 7	405,371	6,303,362	25.34	2.24	8.33	6.64	0.25	0.006	3.59	3.02	0.23	0.004
8	15885	Potential Indigenous Receptor 8	410,297	6,303,663	53.49	2.50	13.52	8.24	0.18	0.004	4.58	3.23	0.60	0.008
9	15886	Potential Indigenous Receptor 9	413,681	6,303,484	51.50	2.61	15.62	8.97	0.15	0.003	4.56	3.21	0.58	0.008
10	15887	Potential Indigenous Receptor 10	411,326	6,299,050	23.45	2.25	8.15	6.76	0.17	0.004	4.33	3.21	0.27	0.006
11	15888	Potential Indigenous Receptor 11	418,775	6,293,108	16.23	2.06	7.31	6.20	0.12	0.003	3.23	2.96	0.09	0.002
12	15889	Potential Indigenous Receptor 12	407,246	6,297,860	23.10	2.20	7.95	6.55	0.21	0.006	3.72	3.07	0.19	0.004
13	15890	Potential Indigenous Receptor 13	404,260	6,295,677	18.78	2.18	7.46	6.37	0.22	0.007	3.38	3.01	0.14	0.005
14	15891	Potential Indigenous Receptor 14	393,110	6,290,821	18.61	2.12	7.75	6.25	0.28	0.008	3.36	2.97	0.15	0.003
15	15892	Potential Indigenous Receptor 15	391,941	6,293,656	21.08	2.18	8.22	6.38	0.35	0.011	3.46	2.99	0.19	0.003
16	15893	Potential Indigenous Receptor 16	386,085	6,295,686	25.96	2.28	8.40	6.47	0.62	0.014	3.70	3.01	0.29	0.004
17	15894	Potential Indigenous Receptor 17	384,540	6,298,769	34.24	2.46	9.41	6.83	0.85	0.020	4.06	3.07	0.37	0.006
18	15895	Potential Indigenous Receptor 18	385,862	6,301,026	41.47	2.61	12.30	7.41	0.90	0.029	4.44	3.12	0.49	0.008
19	15896	Potential Indigenous Receptor 19	383,310	6,302,138	54.34	2.84	13.60	7.92	1.18	0.030	4.99	3.18	0.71	0.010
20	15897	Potential Indigenous Receptor 20	390,169	6,304,646	34.08	2.51	9.09	7.06	1.14	0.032	4.03	3.09	0.40	0.007
21	15898	Potential Indigenous Receptor 21	390,852	6,308,671	35.67	2.42	9.26	6.90	1.23	0.028	3.97	3.06	0.45	0.006
22	15899	Potential Indigenous Receptor 22	372,879	6,313,259	41.07	2.40	11.47	7.23	1.07	0.021	4.01	3.04	0.50	0.005
23	15900	Potential Indigenous Receptor 23	413,807	6,304,728	65.98	2.86	18.42	10.02	0.14	0.003	5.11	3.27	0.94	0.011
24	15901	Potential Indigenous Receptor 24	414,701	6,306,764	**81.45**	3.40	19.70	11.80	0.16	0.003	5.96	3.38	1.65	0.016
25	15902	Potential Indigenous Receptor 25	415,713	6,309,172	67.91	2.70	17.11	10.00	0.16	0.002	4.75	3.14	0.99	0.008
26	15903	Potential Indigenous Receptor 26	414,971	6,295,396	17.75	2.13	8.26	6.45	0.15	0.004	3.43	3.00	0.15	0.003
27	15904	Potential Indigenous Receptor 27	413,079	6,309,406	**95.50**	3.61	44.70	13.52	0.19	0.003	8.45	3.54	2.90	0.021
28	15905	Potential Indigenous Receptor 28	409,795	6,307,422	**82.49**	3.30	25.54	12.84	0.20	0.004	5.99	3.34	1.92	0.015
29	15906	Potential Indigenous Receptor 29	390,569	6,306,510	36.01	2.49	8.90	7.19	1.26	0.033	4.11	3.09	0.44	0.007
30	15907	Potential Indigenous Receptor 30	388,472	6,297,664	27.70	2.33	10.30	6.73	0.60	0.018	3.82	3.04	0.32	0.005
31	15908	Potential Indigenous Receptor 31	381,958	6,298,715	36.57	2.43	9.87	7.24	0.87	0.017	4.01	3.05	0.50	0.006
32	15909	Potential Indigenous Receptor 32	387,332	6,302,851	42.38	2.80	9.71	7.28	1.01	0.032	4.37	3.19	0.63	0.015
33	15910	Potential Indigenous Receptor 33	385,174	6,306,484	71.06	3.63	15.75	10.34	2.72	0.094	6.08	3.47	1.08	0.020

Table IAAC-115-2 Predicted Maximum Ground-level Concentrations at Special Receptors from Project Operation (µg/m³) (including Baseline Conditions)

Receptor ID	Model ID	Receptor Description	UTM Zone 14 NAD 83		NO_2		SO_2		HCN		$PM_{2.5}$		DPM	
			Easting (m)	Northing (m)	1-hour [b]	Annual [c]	1-hour [d]	24-hour [e]	1-hour [f]	Annual	24-hour [g]	Annual [h]	2-hour	Annual
			AAQC [a]		79 [i]	23 [i]	170 [i]	150	40	3	27 [i]	8.8 [i]	10 [j]	5 [j]
34	15911	Potential Indigenous Receptor 34	388,163	6,310,354	38.24	2.42	9.14	7.03	1.73	0.033	4.15	3.07	0.49	0.006
35	15912	Potential Indigenous Receptor 35	385,216	6,312,749	55.23	2.56	10.66	6.95	3.82	0.057	4.54	3.12	0.71	0.007
36	15913	Potential Indigenous Receptor 36	381,162	6,311,003	**83.20**	3.67	18.16	11.04	7.15	0.224	7.35	3.54	1.90	0.021
37	15914	Potential Indigenous Receptor 37	377,971	6,306,944	**91.53**	3.96	36.17	15.74	6.90	0.103	8.40	3.74	2.78	0.026
38	15915	Black Sturgeon Reserve Residence 1	405,449	6,297,916	20.81	2.20	7.85	6.59	0.24	0.007	3.49	3.03	0.18	0.004
39	15916	Black Sturgeon Reserve Residence 2	405,476	6,297,893	20.76	2.20	7.83	6.58	0.24	0.007	3.49	3.03	0.18	0.004
40	15917	Black Sturgeon Reserve Residence 3	405,503	6,297,862	20.79	2.19	7.82	6.58	0.24	0.007	3.49	3.03	0.17	0.004
41	15918	Black Sturgeon Reserve Residence 4	405,527	6,297,835	20.83	2.19	7.81	6.57	0.24	0.006	3.49	3.03	0.17	0.004
42	15919	Black Sturgeon Reserve Residence 5	405,554	6,297,805	20.53	2.19	7.77	6.55	0.23	0.006	3.48	3.02	0.17	0.004
43	15920	Black Sturgeon Reserve Residence 6	405,654	6,297,681	20.55	2.18	7.70	6.52	0.22	0.006	3.47	3.02	0.16	0.004
44	15921	Black Sturgeon Reserve Residence 7	405,720	6,297,721	21.26	2.19	7.73	6.55	0.23	0.006	3.49	3.03	0.17	0.004
45	15922	Black Sturgeon Reserve Residence 8	405,738	6,297,699	21.16	2.19	7.73	6.54	0.22	0.006	3.49	3.03	0.17	0.004
46	15923	Black Sturgeon Reserve Residence 9	405,753	6,297,679	21.05	2.19	7.73	6.54	0.22	0.006	3.49	3.03	0.17	0.004
47	15924	Black Sturgeon Reserve Residence 10	405,765	6,297,661	21.12	2.19	7.74	6.54	0.22	0.006	3.49	3.03	0.17	0.004
48	15925	Black Sturgeon Reserve Residence 11	405,778	6,297,640	21.10	2.19	7.74	6.54	0.22	0.006	3.49	3.03	0.17	0.004
49	15926	Black Sturgeon Reserve Residence 12	405,794	6,297,624	21.07	2.19	7.74	6.53	0.22	0.006	3.49	3.03	0.17	0.004
50	15927	Black Sturgeon Reserve Residence 13	405,807	6,297,597	20.69	2.18	7.73	6.52	0.22	0.006	3.48	3.02	0.16	0.004
51	15928	Black Sturgeon Reserve Residence 14	405,827	6,297,574	20.78	2.18	7.74	6.52	0.22	0.006	3.48	3.03	0.16	0.004
52	15929	Black Sturgeon Reserve Infrastructure	405,437	6,298,013	20.79	2.20	7.87	6.60	0.25	0.007	3.50	3.03	0.18	0.004
53	15930	Black Sturgeon Reserve Potential Residence 1	405,679	6,297,662	20.84	2.18	7.72	6.53	0.22	0.006	3.48	3.02	0.16	0.004
54	15931	Black Sturgeon Reserve Potential Residence 2	405,817	6,297,522	20.40	2.18	7.73	6.50	0.22	0.006	3.47	3.02	0.16	0.004
55	15932	Remote Cottage	400,748	6,295,006	20.92	2.37	7.58	6.31	0.28	0.008	3.62	3.06	0.43	0.012
56	15933	Remote Cottage	387,607	6,298,666	30.80	2.39	10.94	6.84	0.64	0.020	3.94	3.06	0.35	0.006
57	15934	Remote Cottage	377,549	6,294,140	23.41	2.14	7.98	6.72	0.58	0.008	3.54	2.97	0.26	0.003
58	15935	Float Plane	376,983	6,299,203	38.06	2.30	9.50	7.14	0.86	0.012	3.87	3.01	0.52	0.004
59	15936	Admin Site	376,689	6,299,267	41.67	2.31	9.69	7.13	0.92	0.012	3.89	3.01	0.54	0.004
60	15937	Fish Farm	374,507	6,299,055	33.09	2.25	9.94	7.00	0.91	0.011	3.77	3.00	0.43	0.004
61	15938	Lagoon	375,360	6,300,756	42.09	2.36	11.60	7.46	1.18	0.015	4.12	3.03	0.56	0.005
62	15939	Warehouse Site	374,586	6,300,811	38.09	2.33	11.09	7.30	1.01	0.014	4.02	3.02	0.48	0.004
63	15940	Highway Maintenance Yard	374,631	6,300,577	37.37	2.32	10.99	7.28	1.00	0.013	3.98	3.01	0.47	0.004
64	15941	Recreation Site	375,594	6,303,042	51.45	2.56	9.95	7.67	1.73	0.022	4.70	3.09	0.74	0.007

Table IAAC-115-2 Predicted Maximum Ground-level Concentrations at Special Receptors from Project Operation (µg/m³) (including Baseline Conditions)

Receptor ID	Model ID	Receptor Description	UTM Zone 14 NAD 83		NO_2		SO_2		HCN		$PM_{2.5}$		DPM	
			Easting (m)	Northing (m)	1-hour[b]	Annual[c]	1-hour[d]	24-hour[e]	1-hour[f]	Annual	24-hour[g]	Annual[h]	2-hour	Annual
			AAQC[a]		79[i]	23[i]	170[i]	150	40	3	27[i]	8.8[i]	10[j]	5[j]
65	15942	Dog Kennel	373,388	6,302,976	38.45	2.38	9.26	7.22	1.25	0.018	4.09	3.03	0.47	0.005
66	15943	Museum Site	375,014	6,302,733	45.84	2.48	9.27	7.48	1.41	0.019	4.45	3.06	0.63	0.006
67	15944	Communication Site	376,000	6,303,559	57.63	2.66	10.29	7.88	2.00	0.027	4.99	3.12	0.85	0.008
68	15945	Waste Disposal Site	379,757	6,304,945	**88.70**	3.75	29.71	15.45	4.12	0.055	8.36	3.60	2.65	0.025
69	15946	Remote Cottage	374,038	6,307,949	61.32	2.73	12.01	7.57	2.14	0.035	4.84	3.14	0.83	0.008
70	15947	Riding Stable	374,369	6,307,586	62.86	2.79	12.83	7.98	2.36	0.035	4.96	3.16	0.91	0.009
71	15948	Recreation Lot	375,069	6,307,961	68.51	2.96	14.60	8.14	2.58	0.042	5.33	3.21	1.06	0.011
72	15949	Recreation Lot	375,124	6,308,104	70.19	2.99	14.91	8.21	2.78	0.045	5.32	3.22	1.05	0.011
73	15951	Potential Indigenous Receptor 38	376,617	6,308,656	**84.52**	3.65	22.39	10.60	3.27	0.069	7.26	3.45	1.87	0.019
74	15984	Remote Cottage	376,126	6,308,197	78.17	3.32	18.71	9.35	2.77	0.052	6.09	3.33	1.42	0.015
75	15952	Trapper Cabin	392,947	6,312,606	22.99	2.19	7.97	6.46	0.79	0.013	3.53	2.99	0.23	0.003
76	15953	Recreation Lot	404,536	6,296,516	18.80	2.17	7.50	6.42	0.22	0.007	3.39	3.01	0.14	0.004
77	15954	Recreation Lot	404,567	6,296,540	18.90	2.18	7.50	6.43	0.22	0.007	3.39	3.01	0.15	0.004
78	15955	Remote Cottage	404,780	6,296,541	18.98	2.17	7.49	6.42	0.22	0.007	3.40	3.01	0.15	0.004
79	15956	Remote Cottage	404,865	6,296,554	19.09	2.18	7.49	6.43	0.22	0.007	3.41	3.01	0.15	0.004
80	15957	Remote Cottage	404,882	6,296,557	19.19	2.18	7.49	6.43	0.22	0.007	3.41	3.01	0.15	0.004
81	15958	Remote Cottage	404,909	6,296,538	19.12	2.18	7.49	6.43	0.22	0.007	3.41	3.01	0.15	0.004
82	15959	Remote Cottage	410,520	6,303,729	54.64	2.52	13.83	8.13	0.18	0.004	4.67	3.26	0.62	0.008
83	15960	Trapper Cabin	413,593	6,304,211	60.83	2.74	16.68	9.84	0.14	0.003	4.80	3.25	0.76	0.010
84	15991	Lynn Lake Friendship Centre	375,309	6,303,206	51.51	2.55	9.79	7.64	1.71	0.023	4.58	3.09	0.70	0.007
85	15992	Marcel Colomb First Nation Centre	374,748	6,302,611	43.51	2.45	9.10	7.42	1.40	0.018	4.32	3.05	0.58	0.006
86	15993	St. Simon's Church	374,934	6,301,646	42.35	2.39	10.99	7.47	1.18	0.016	4.15	3.04	0.54	0.005
87	15994	Lynn Lake Gospel Church	375,219	6,302,737	47.06	2.49	9.62	7.54	1.48	0.019	4.50	3.07	0.65	0.006
88	15995	St. Maria Goretti Catholic Church	374,949	6,302,645	44.81	2.47	9.25	7.45	1.36	0.019	4.41	3.06	0.61	0.006
89	15996	Misc. Commercial	375,877	6,303,715	59.13	2.67	10.50	7.86	1.96	0.028	4.96	3.13	0.82	0.008
90	15997	Lynn Lake Library	375,129	6,302,767	46.69	2.49	9.42	7.50	1.45	0.020	4.50	3.07	0.64	0.006
91	15998	Royal Canadian Mounted Police (RCMP)	375,194	6,302,913	48.29	2.51	9.32	7.55	1.51	0.021	4.53	3.07	0.66	0.006
92	15999	Town of Lynn Lake	375,137	6,302,770	46.76	2.49	9.43	7.51	1.46	0.020	4.50	3.07	0.64	0.006
93	16000	West Lynn Lake Heights School	374,770	6,302,635	43.95	2.45	9.11	7.43	1.42	0.018	4.34	3.05	0.58	0.006
94	16001	Lynn Lake Hospital	375,423	6,303,359	53.77	2.58	9.90	7.69	1.81	0.025	4.68	3.10	0.72	0.007
95	16002	Addictions Foundation-Manitoba	375,290	6,303,212	51.43	2.55	9.79	7.64	1.72	0.023	4.58	3.09	0.69	0.007
96	16003	The Bronx	375,318	6,303,254	51.97	2.56	9.82	7.65	1.74	0.023	4.59	3.09	0.70	0.007
97	16004	Lynn Lake Inn	375,188	6,302,784	47.18	2.50	9.51	7.53	1.48	0.020	4.52	3.07	0.65	0.006

Table IAAC-115-2 Predicted Maximum Ground-level Concentrations at Special Receptors from Project Operation (µg/m³) (including Baseline Conditions)

Receptor ID	Model ID	Receptor Description	UTM Zone 14 NAD 83		NO_2		SO_2		HCN		$PM_{2.5}$		DPM	
			Easting (m)	Northing (m)	1-hour [b]	Annual [c]	1-hour [d]	24-hour [e]	1-hour [f]	Annual	24-hour [g]	Annual [h]	2-hour	Annual
			AAQC [a]		79 [i]	23 [i]	170 [i]	150	40	3	27 [i]	8.8 [i]	10 [j]	5 [j]
98	16005	Residential 1 - Halstead Ave.	375,653	6,303,322	54.70	2.60	9.82	7.74	1.78	0.025	4.78	3.10	0.76	0.008
99	16006	Residential 2 - Halstead Ave.	375,648	6,303,244	54.04	2.59	9.76	7.72	1.80	0.024	4.79	3.10	0.76	0.007
100	16007	Residential 3 - Halstead Ave.	375,580	6,303,211	53.39	2.58	9.65	7.69	1.73	0.023	4.74	3.09	0.74	0.007
101	16008	Residential 4 - Halstead Ave.	375,564	6,303,122	52.09	2.57	9.79	7.67	1.72	0.023	4.73	3.09	0.74	0.007
102	16009	Residential 5 - Halstead Ave.	375,436	6,302,927	49.58	2.53	9.78	7.61	1.63	0.021	4.62	3.08	0.70	0.007
103	16010	Residential 6 - Halstead Ave.	375,356	6,302,854	48.42	2.52	9.73	7.59	1.56	0.020	4.57	3.07	0.68	0.007
104	16011	Residential 7 - Camp St.	375,492	6,303,237	53.25	2.57	9.70	7.68	1.67	0.024	4.68	3.09	0.73	0.007
105	16012	Residential 8 - Hales Ave.	375,395	6,303,225	52.36	2.56	9.76	7.66	1.69	0.023	4.63	3.09	0.71	0.007
106	16013	Residential 9 - Hales Ave.	375,345	6,303,102	50.84	2.54	9.52	7.62	1.59	0.022	4.61	3.08	0.70	0.007
107	16014	Residential 10 - Hales Ave.	375,278	6,303,050	49.91	2.53	9.43	7.60	1.57	0.022	4.57	3.08	0.68	0.007
108	16015	Residential 11 - Hales Ave.	375,273	6,302,997	49.38	2.52	9.36	7.59	1.54	0.021	4.56	3.08	0.68	0.007
109	16016	Residential 12 - Hales Ave.	375,232	6,302,932	48.42	2.51	9.34	7.56	1.51	0.021	4.54	3.07	0.67	0.007
110	16017	Residential 13 - Gordon Ave.	375,365	6,303,284	52.67	2.56	9.84	7.66	1.76	0.024	4.62	3.09	0.71	0.007
111	16018	Residential 14 - Gordon Ave.	375,277	6,303,205	51.24	2.55	9.79	7.63	1.72	0.023	4.57	3.08	0.69	0.007
112	16019	Residential 15 - Gordon Ave.	375,286	6,303,158	50.57	2.54	9.70	7.63	1.67	0.022	4.57	3.08	0.69	0.007
113	16020	Residential 16 - Highway 391	375,469	6,303,189	52.73	2.56	9.62	7.67	1.66	0.023	4.68	3.09	0.72	0.007
114	16021	Residential 17 - Highway 391	375,419	6,303,055	50.44	2.54	9.53	7.62	1.62	0.022	4.64	3.08	0.70	0.007
115	16022	Residential 18 - Highway 391	375,347	6,303,003	49.57	2.53	9.44	7.60	1.58	0.022	4.60	3.08	0.69	0.007
116	16023	Residential 19 - Highway 391	375,322	6,302,909	48.70	2.52	9.59	7.57	1.56	0.021	4.59	3.08	0.68	0.007
117	16024	Residential 20 - Highway 391	375,213	6,302,842	47.63	2.50	9.47	7.53	1.49	0.020	4.53	3.07	0.66	0.006
118	16025	Residential 21 - Highway 391	375,062	6,302,716	45.98	2.48	9.37	7.48	1.42	0.019	4.47	3.06	0.63	0.006
119	16026	Residential 22 - Halstead Ave.	375,328	6,302,773	47.81	2.51	9.78	7.59	1.52	0.020	4.51	3.07	0.67	0.006
120	16027	Residential 23 - Halstead Ave.	375,140	6,302,694	46.21	2.48	9.53	7.52	1.43	0.019	4.47	3.06	0.63	0.006
121	16028	Residential 24 - Halstead Ave.	375,064	6,302,622	45.34	2.47	9.49	7.49	1.40	0.019	4.43	3.06	0.62	0.006
122	16029	Residential 25 - Cobalt Pl	374,840	6,302,860	45.92	2.47	9.36	7.49	1.56	0.019	4.36	3.06	0.60	0.006
123	16030	Residential 26 - Silver St.	374,781	6,302,784	45.30	2.46	9.24	7.46	1.53	0.019	4.35	3.06	0.59	0.006
124	16031	Residential 27 - Silver St.	374,865	6,302,699	44.88	2.46	9.16	7.45	1.44	0.019	4.37	3.06	0.60	0.006
125	16032	Residential 28 - McVeigh Ave.	374,902	6,302,535	44.05	2.45	9.27	7.44	1.35	0.018	4.39	3.05	0.60	0.006
126	16033	Residential 29 - McVeigh Ave.	374,901	6,302,479	43.82	2.45	9.32	7.45	1.36	0.018	4.37	3.05	0.60	0.006
127	16034	Residential 30 - McVeigh Ave.	374,946	6,302,404	43.62	2.45	9.49	7.47	1.37	0.018	4.32	3.05	0.60	0.006
128	16035	Residential 31 - Sherritt Ave.	374,812	6,302,500	43.27	2.44	9.17	7.41	1.30	0.018	4.36	3.05	0.58	0.006
129	16036	Residential 32 - Sherritt Ave.	374,774	6,302,444	42.86	2.44	9.15	7.40	1.29	0.018	4.34	3.05	0.58	0.006
130	16037	Residential 33 - Sherritt Ave.	374,781	6,302,380	42.69	2.43	9.20	7.41	1.31	0.018	4.32	3.05	0.58	0.006

Table IAAC-115-2 Predicted Maximum Ground-level Concentrations at Special Receptors from Project Operation (µg/m³) (including Baseline Conditions)

Receptor ID	Model ID	Receptor Description	UTM Zone 14 NAD 83		NO_2		SO_2		HCN		$PM_{2.5}$		DPM	
			Easting (m)	Northing (m)	1-hour [b]	Annual [c]	1-hour [d]	24-hour [e]	1-hour [f]	Annual	24-hour [g]	Annual [h]	2-hour	Annual
			AAQC [a]		79 [i]	23 [i]	170 [i]	150	40	3	27 [i]	8.8 [i]	10 [j]	5 [j]
131	16038	Residential 34 - Sherritt Ave.	374,771	6,302,337	42.46	2.43	9.23	7.41	1.28	0.017	4.29	3.05	0.57	0.006
132	16039	Residential 35 - Sherritt Ave.	374,811	6,302,283	42.41	2.43	9.40	7.43	1.30	0.017	4.26	3.05	0.57	0.006
133	16040	Residential 36 - Sherritt Ave.	374,799	6,302,228	42.13	2.42	9.48	7.43	1.30	0.017	4.23	3.05	0.57	0.005
134	16041	Residential 37 - Sherritt Ave.	374,832	6,302,191	42.29	2.42	9.62	7.44	1.32	0.017	4.24	3.05	0.57	0.005
135	16042	Residential 38 - Sherritt Ave.	374,847	6,302,061	41.79	2.41	9.92	7.45	1.27	0.017	4.19	3.04	0.56	0.005
136	16043	Residential 39 - Sherritt Ave.	374,891	6,302,000	42.09	2.41	10.15	7.46	1.27	0.017	4.20	3.04	0.56	0.005
137	16044	Residential 40 - Sherritt Ave.	374,880	6,301,883	41.58	2.40	10.36	7.46	1.25	0.016	4.19	3.04	0.56	0.005
138	16045	Residential 41 - Sherritt Ave.	374,901	6,301,799	41.79	2.40	10.59	7.46	1.22	0.016	4.18	3.04	0.55	0.005
139	16046	Residential 42 - Sherritt Ave.	374,862	6,301,713	41.90	2.39	10.66	7.45	1.20	0.016	4.16	3.04	0.54	0.005
140	16047	Residential 43 - Sherritt Ave.	374,884	6,301,642	42.21	2.39	10.86	7.45	1.18	0.016	4.14	3.03	0.54	0.005
141	16048	Residential 44 - Edmon Ave.	374,846	6,302,446	43.34	2.44	9.24	7.43	1.33	0.018	4.35	3.05	0.59	0.006
142	16049	Residential 45 - Edmon Ave.	374,849	6,302,371	43.05	2.44	9.32	7.44	1.34	0.018	4.31	3.05	0.59	0.006
143	16050	Residential 46 - Edmon Ave.	374,867	6,302,297	42.77	2.43	9.50	7.45	1.34	0.018	4.27	3.05	0.58	0.006
144	16051	Residential 47 - Edmon Ave.	374,906	6,302,243	42.80	2.43	9.70	7.46	1.35	0.018	4.26	3.05	0.59	0.006
145	16052	Residential 48 - Edmon Ave.	374,901	6,302,177	42.54	2.43	9.82	7.46	1.34	0.017	4.24	3.05	0.58	0.006
146	16053	Residential 49 - Edmon Ave.	374,918	6,302,113	42.42	2.42	9.99	7.47	1.32	0.017	4.23	3.05	0.58	0.005
147	16054	Residential 50 - Edmon Ave.	374,958	6,301,988	42.23	2.42	10.36	7.49	1.28	0.017	4.22	3.04	0.57	0.005
148	16055	Residential 51 - Edmon Ave.	374,953	6,301,931	41.96	2.41	10.46	7.48	1.27	0.016	4.21	3.04	0.56	0.005
149	16056	Residential 52 - Edmon Ave.	374,963	6,301,833	42.29	2.41	10.70	7.48	1.24	0.016	4.20	3.04	0.56	0.005
150	16057	Residential 53 - Edmon Ave.	374,980	6,301,752	42.94	2.40	10.91	7.49	1.21	0.016	4.18	3.04	0.55	0.005
151	16058	Residential 54 - Edmon Ave.	374,947	6,301,686	42.54	2.40	10.95	7.47	1.20	0.016	4.16	3.04	0.54	0.005
152	16059	Residential 55 - Edmon Ave.	374,964	6,301,630	42.47	2.39	11.11	7.48	1.18	0.016	4.15	3.04	0.54	0.005
153	16060	Residential 56 - McVeigh Ave. S.	375,078	6,301,916	43.08	2.42	10.83	7.53	1.27	0.017	4.23	3.04	0.58	0.005
154	16061	Residential 57 - McVeigh Ave. S.	375,047	6,301,857	43.09	2.41	10.87	7.51	1.25	0.016	4.21	3.04	0.57	0.005
155	16062	Residential 58 - McVeigh Ave. S.	375,043	6,301,793	43.29	2.41	10.99	7.51	1.22	0.016	4.19	3.04	0.56	0.005
156	16063	Residential 59 - Halstead Ave. S.	375,129	6,301,986	43.26	2.43	10.80	7.54	1.29	0.017	4.26	3.05	0.58	0.006
157	16064	Residential 60 - Halstead Ave. S.	375,077	6,301,688	43.05	2.40	11.28	7.51	1.19	0.016	4.18	3.04	0.55	0.005
158	16065	Residential 61 - Zinc St.	375,032	6,301,617	42.73	2.40	11.31	7.50	1.17	0.016	4.16	3.04	0.55	0.005
159	16066	Residential 62 - Zinc St.	374,812	6,301,685	41.55	2.39	10.58	7.43	1.19	0.016	4.15	3.03	0.53	0.005
160	16070	Permanent Work Camp	380,916	6,308,622	**131.29**	9.06	96.20	22.42	30.93	1.284	**27.57**	7.18	**11.46**	0.124

NOTES:

[a] Manitoba Ambient Air Quality Criteria (MSD 2005) unless otherwise noted.

[b] The 1-hour CAAQS for NO_2 is referenced to the three-year average of the annual 98th percentile of the NO_2 daily maximum 1-hour average concentrations (effective 2025) (CCME 2017).

[c] The annual CAAQS for NO_2 is referenced to the arithmetic average over a single calendar year of all 1-hour average NO_2 concentrations (effective 2025) (CCME 2017).

Table IAAC-115-2 Predicted Maximum Ground-level Concentrations at Special Receptors from Project Operation (µg/m³) (including Baseline Conditions)

Receptor ID	Model ID	Receptor Description	UTM Zone 14 NAD 83		NO_2		SO_2		HCN		$PM_{2.5}$		DPM	
			Easting (m)	Northing (m)	1-hour [b]	Annual [c]	1-hour [d]	24-hour [e]	1-hour [f]	Annual	24-hour [g]	Annual [h]	2-hour	Annual
			AAQC [a]		79 [i]	23 [i]	170 [i]	150	40	3	27 [i]	8.8 [i]	10 [j]	5 [j]

[d] The 1-hour CAAQS for SO_2 is referenced to the three-year average of the annual 99th percentile of the SO_2 daily maximum 1-hour average concentrations (effective 2025) (CCME 2017).

[e] The annual CAAQS for SO_2 is referenced to the arithmetic average over a single calendar year of all 1-hour average SO_2 concentrations (effective 2025) (CCME 2017).

[f] The maximum 1-hour concentration after eliminating 8 highest meteorological hours in each year

[g] The CAAQS for 24-hour $PM_{2.5}$ is referenced to the annual 98th percentile of daily 24-hour average concentrations, averaged over three years (effective 2020) (CCME 2017).

[h] The CAAQS for annual $PM_{2.5}$ is referenced to the three-year mean of annual average concentrations (effective 2020) (CCME, 2017).

[i] CAAQS (CCME 2017)

[j] Health Canada (2016)

Predicted maximum 1-hour and 8-hour average concentrations are based on maximum hourly emission rates.

Predicted maximum 24-hour, 30-day and annual average concentrations are based on daily average emission rates.

The DPM baseline concentration is assumed to be zero.

Values in **BOLD** text and shaded cell exceed the AAQC.

A.26 ATTACHMENT IAAC-118

Table IAAC-118-1 Ambient NO_2 Concentration Odour Thresholds

Odourant	Detection Threshold [a]		Recognition Threshold [b]	
	(ppb)	(µg/m^3)	(ppb)	(µg/m^3)
NO_2	120	226	390	734

NOTES:

[a] Nagata, Y. 2003. Measurement of Odour Threshold by Triangle Odour Bag Method. Odour measurement review, 118-127.

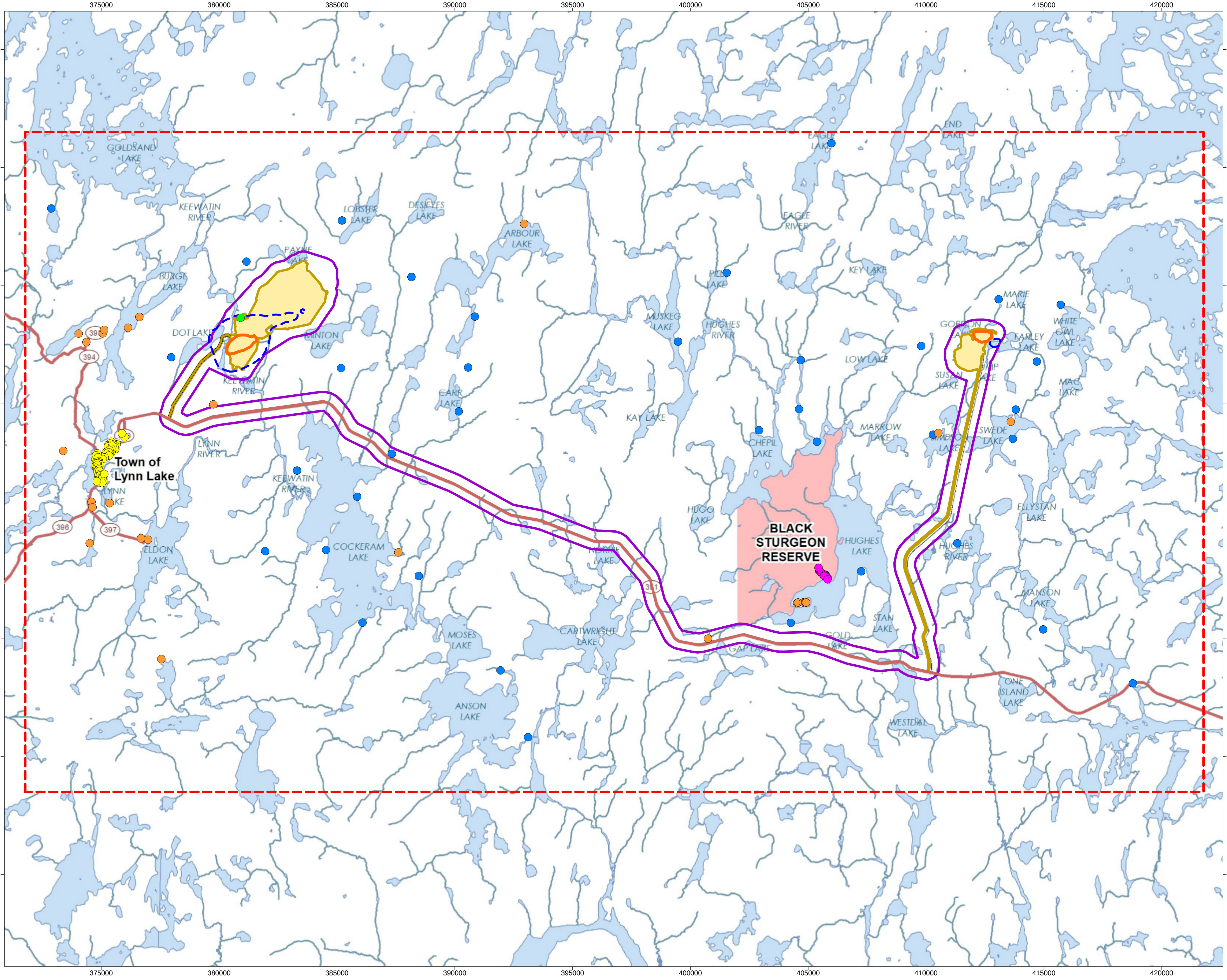
[b] Amoore, J.E. and Hautala, E. (1983). Odour as an Aid to Chemical Safety: Odour Thresholds Compared with Threshold Limit Values and Volatilities for 214 Industrial Chemicals in Air and Water Dilution. J. Appl. Toxicol. 3(6):272-290.

van Gemert, L.J. 2011. Odour Thresholds. Compilation of Odour Threshold Values in Air, Water and Other Media. Published by Oliemans Punter & Partners BV, The Netherlands.

European Commission. 2014. Recommendation from the Scientific Committee on Occupational Exposure Limits for Nitrogen Dioxide. SCOEL/SUM/53. Scientific Committee on Occupational Exposure Limits (SCOEL). June 2014.

Odour thresholds from Amoore and Hautala (1983) are geometric means of collected literature data, primarily from van Gemert compilation of odour thresholds (1977, 1980). The latest edition of van Gemert compilation of odour thresholds is provided for reference (van Gemert 2011).

Map IAAC-118-1 Area Associated with Odour due to NO_2 (Project Operation + Baseline Conditions)



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Stantec

ALAMOS GOLD INC.

Study Area

- 🟧 Proposed Open Pit
- 🟨 Project Development Area
- 🟪 Project Boundary
- 🟥 Air Quality Local Assessment Area

Human Receptors

- ● Lynn Lake Receptors
- ● Black Sturgeon Reserve Receptors
- ● Human Receptors
- ● Potential Indigenous Receptor
- ● Worker Camp

Landbase

- — Highway
- = Access Road
- — Watercourse
- 🟦 Waterbody
- 🟥 First Nation Reserve

Odour Concentrations

- - - Odour Detection Threshold: 226 µg/m³
- — Odour Recognition Threshold: 734 µg/m³

Background Concentration: 7.5 µg/m³

Compliance Percentile: 99.5% (44 hours)

N

0 1500 3000 4500 6000 Metres

(At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

Project Location
Lynn Lake,
Manitoba

Prepared by IYankova on 2021-06-01
Technical Review by DJarratt on 2021-06-01

Client/Project
111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-118-1

Title

Area Associated with Odour due to NO_2 (Project Operation + Baseline Conditions)

A.27 ATTACHMENT IAAC-120

Table IAAC-120-1 Project Decommissioning GHG Emissions

Activity/Site	CO_2 (tonnes/year)	CH_4 (tonnes/year)	N_2O (tonnes/year)	CO_2e (tonnes/year)
Off-Road Diesel Exhaust Emissions	3,569	0.097	0.302	3,661
On-Highway Truck Exhaust Emissions (Summer)	84	0.003	0.000	84
Drilling & Blasting	33	0.000	0.000	33
MacLellan	**3,686**	**0.100**	**0.302**	**3,778**
Off-Road Diesel Exhaust Emissions	384	0.010	0.033	394
On-Highway Truck Exhaust Emissions (Summer)	52	0.002	0.000	52
Drilling & Blasting	13	0.000	0.000	13
Gordon	**450**	**0.013**	**0.033**	**460**
Total	**4,135**	**0.112**	**0.335**	**4,238**

NOTE:

Emissions estimated for Gordon and MacLellan site are based on assumptions that decommissioning emissions are about 30% of construction emissions, respectively. Totals may not add up perfectly due to number rounding.

Table IAAC-120-2 Project Construction, Operation, and Decommissioning GHG Emissions

Year	Gordon site Emissions, tCO_2e [a]	MacLellan site Emissions, tCO_2e [b]
Construction	16,024	64,594
1	31,351	33,379
2	36,546	38,235
3	32,420	43,621
4	24,784	53,403
5	7,613	59,474
6	0	68,030
7	0	68,028
8	0	65,568
9	0	59,476
10	0	55,347
11	0	42,964
12	0	26,958
13	0	4,462
Decommissioning [c]	460	3,778
Total	**149,197**	**687,316**

NOTES:

[a.] Gordon site yearly emissions are projected using the emission intensity calculated based on Year 2 operations.

[b.] MacLellan site yearly emissions are projected using the emission intensity calculated based on Year 7 operation.

[c.] Emissions estimated for Gordon and MacLellan sites are based on assumptions that decommissioning emissions are about 30% of construction emissions, respectively.

Table IAAC-120-3 Project GHG Emissions by Individual Pollutants (Gordon and MacLellan sites) [a,b]

Year	CO_2 (tonnes/year)	CH_4 (tonnes/year)	N_2O (tonnes/year)	CO_2e (tonnes/year)
Construction	34,853	0.929	2.83	80,618
1	63,246	1.66	4.84	64,730
2	73,068	1.92	5.59	74,781
3	74,281	1.96	5.74	76,040
4	76,348	2.02	6.00	78,187
5	65,460	1.74	5.31	67,087
6	66,352	1.78	5.48	68,030
7	66,350	1.78	5.48	68,028
8	63,951	1.71	5.28	65,568
9	58,009	1.55	4.79	59,476
10	53,982	1.44	4.46	55,347
11	41,904	1.12	3.46	42,964
12	26,294	0.704	2.17	26,958
13	4,352	0.116	0.360	4,462
Decommissioning	4,135	0.112	0.335	4,238
Total	**772,584**	**20.5**	**62.1**	**836,514**

NOTES:

[a] Totals may not exactly match due to rounding.

[b] Values for CO_2e may not exactly match the breakdown to CO_2, CH4 and N_2O, as values are rounded and the construction emissions of CO_2e include land clearing emissions (tCO_2e).

A.28 ATTACHMENT IAAC-121

Table IAAC-121-1 Comparison of Annual Emission Rates for Diesel Generator Tier 3 and Tier 4 at Gordon Site (Gordon Site Operation)

Emission Standard	Emission Source	Annual Emission Rates [a] (t/y)									
		NO_X	CO	SO_2 [e]	DTSP	DPM_{10}	$DPM_{2.5}$	FTSP	FPM_{10}	$FPM_{2.5}$	VOC
Tier 3	Emission Factors (g/hp-hr) [b, c]	3.90	0.520	0.025	0.040	0.040	0.039	-	-	-	0.271
	Diesel Generator [b]	11.7	1.56	0.015	0.120	0.120	0.116	-	-	-	0.811
	Total Emissions (Gordon Operation)	**176**	**276**	**4.23**	**2.78**	**2.78**	**2.31**	**1,775**	**623**	**70.9**	**9.84**
	Contribution of Generator to Total Emissions (%)	7%	0.6%	0.4%	4%	4%	5%	0%	0%	0%	8%
Tier 4	Emission Factors (g/hp-hr) [d, c]	0.300	0.520	0.025	0.015	0.015	0.015	-	-	-	0.154
	Diesel Generator	0.899	7.79	0.015	0.045	0.045	0.044	-	-	-	0.461
	Total Emissions (Gordon Operation)	**165**	**276**	**4.23**	**2.71**	**2.71**	**2.24**	**1,775**	**623**	**70.9**	**9.50**
Percent Reduction in Diesel Generator Emissions from Tier 3 to Tier 4 (%)		92%	0%	0%	63%	63%	63%	-	-	-	43%
Percent Reduction in Total Emissions from Tier 3 to Tier 4 (%)		6%	0%	0%	3%	3%	3%	0%	0%	0%	4%

NOTES:

[a] Annual average emission rates based on the actual hours of operation per day for each mining activity.

[b] Emission factors and emission rates based on manufacturer specifications for US EPA Tier 3 certified diesel generator set MTU 6R1600 DS300.

[c] Emission factors for NO_X, CO, DTSP, DPM_{10} and $DPM_{2.5}$ in (g/hp-hr); emission factor for SO_2 in (g/L).

[d] Tier 4 emission standards for off-road diesel engines (ECCC 2005).

[e] SO_2 emission factor and emission rate based on amount of sulphur in diesel fuel (15 ppm).

DTSP, DPM_{10}, $DPM_{2.5}$ – diesel particulate matter of different particle size ranges.

FTSP, FPM_{10}, $FPM_{2.5}$ – fugitive particulate matter of different particle size ranges.

“-“ Not applicable

A.29 ATTACHMENT IAAC-125

Table IAAC-125-1 Proposed Ambient Air Quality Monitoring Locations

Monitoring Station	Parameters Measured	UTM Zone	Easting (m)	Northing (m)	Upwind (U)/ Downwind (D)/ Community (C)	Rationale for Selected Location
Station A	TSP, PM_{10} and $PM_{2.5}$ (continuous)	14V	375,536	6,307,990	U/D	Predominantly upwind station located at Burge Lake Provincial Park, approximately 4.9 km west of MacLellan site and in a predominantly upwind location from MacLellan site. Downwind of the MacLellan site during easterly and southeasterly winds.
Station B	TSP, PM_{10} and $PM_{2.5}$ (continuous)	14V	375,805	6,303,174	C	Community monitoring station in Lynn Lake, approximately 6.2 km south of MacLellan site. The proposed location coincides with the baseline dustfall station in Lynn Lake.
Station C	TSP, PM_{10} and $PM_{2.5}$ (continuous) Automated Meteorological Station	14V	380,851	6,308,569	D	Monitoring station at the permanent work camp at MacLellan site. An automated meteorological monitoring station is also proposed to be installed at this location. Continuous PM monitoring data will be used for adaptive management of dust emissions at the MacLellan site.
Station D	TSP, PM_{10} and $PM_{2.5}$ (continuous) Automated Meteorological Station	14V	412,536	6,307,031	D	Monitoring station at the entry gate of Gordon site. This air quality station will be representative of the ambient air quality at the Black Sturgeon Reserve. An automated meteorological monitoring station is also proposed to be installed at this location. Continuous PM monitoring data will be used for adaptive management of dust emissions at the Gordon site.

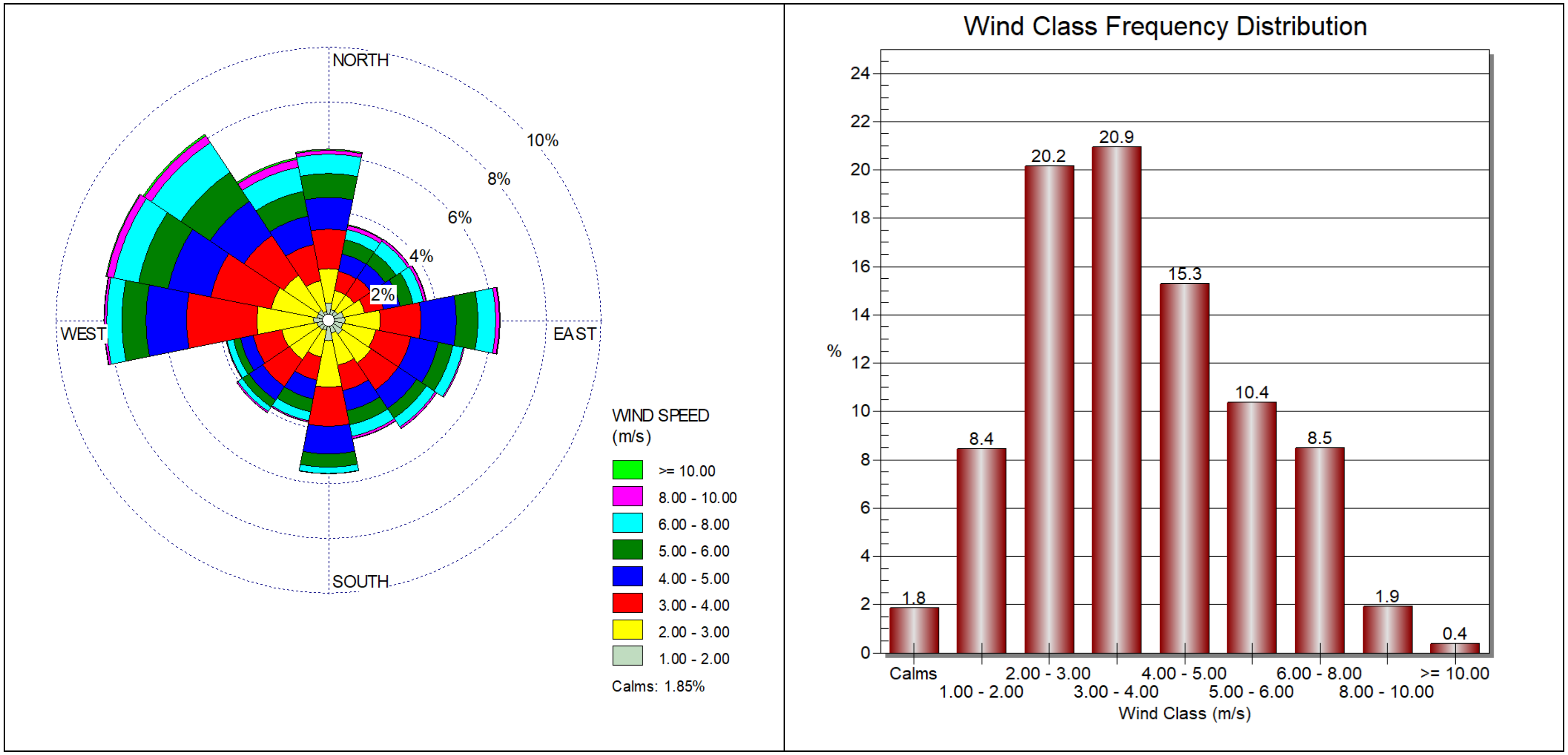
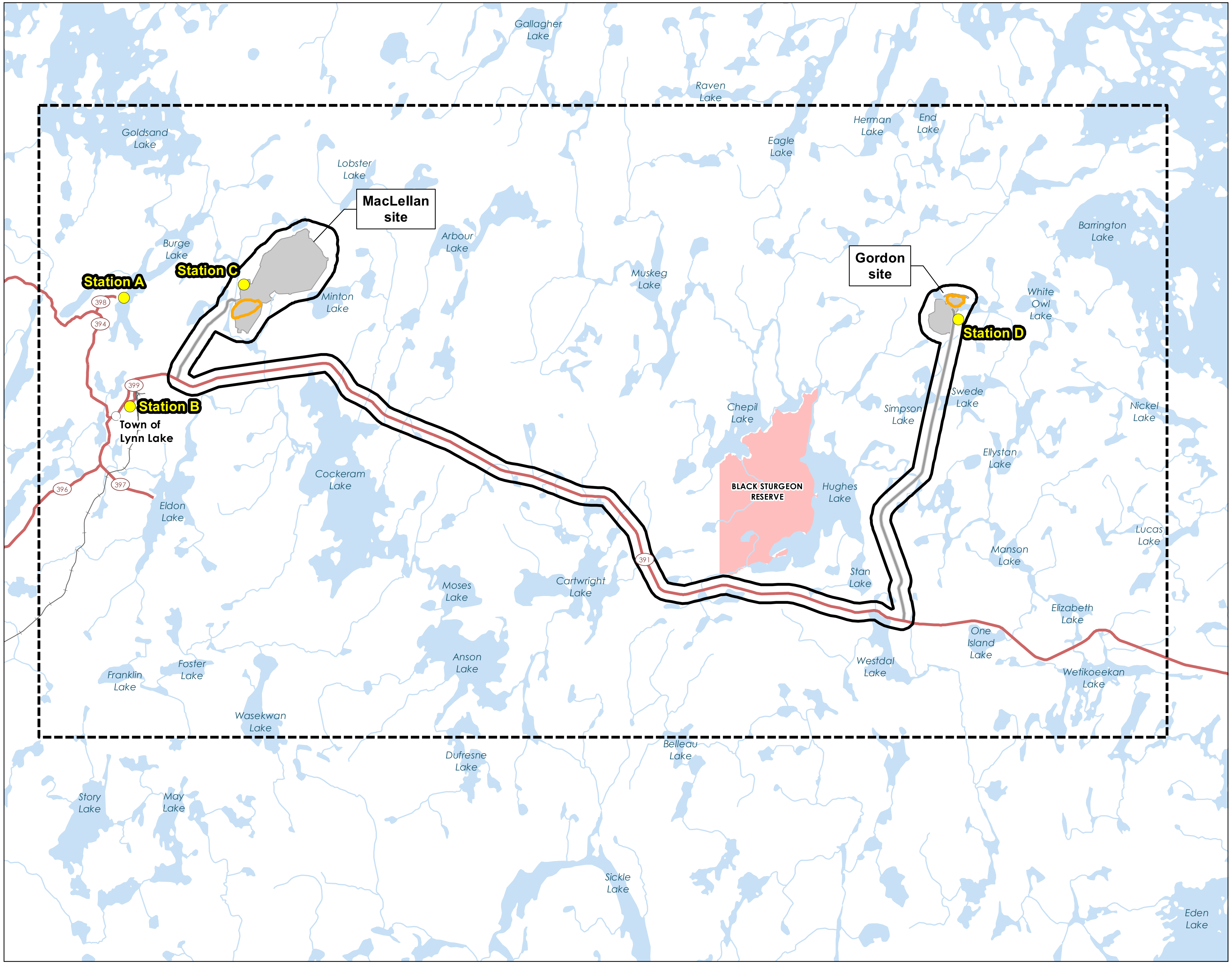


Figure IAAC-125-1 Wind Rose and Wind Frequency Distribution Diagram at Lynn Lake Airport, Manitoba (2015-2018)

Map IAAC-125-1 Proposed Ambient Air Quality Monitoring Stations



Stantec

Project Infrastructure
- ▭ Proposed Open Pit
- ▨ Project Development Area

Study Area
- ● Proposed Ambient Air Quality Station
- ▭ Project Boundary
- ⬚ Air Quality Local Assessment Area

Landbase
- — Highway
- — Access Road
- —+— Rail
- — Watercourse
- ▨ Waterbody
- ▨ First Nation Reserve

N

0 2.5 5
Kilometres

(At original document size of 11x17)
1:175,000

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

Project Location
Lynn Lake,
Manitoba

Prepared by ACampigotto on 2021-06-01
Technical Review by IYankova on 2021-06-01

Client/Project 111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
IAAC-125-1

Title
Proposed Ambient Air Quality Monitoring Stations

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A.30 ATTACHMENT IAAC-127

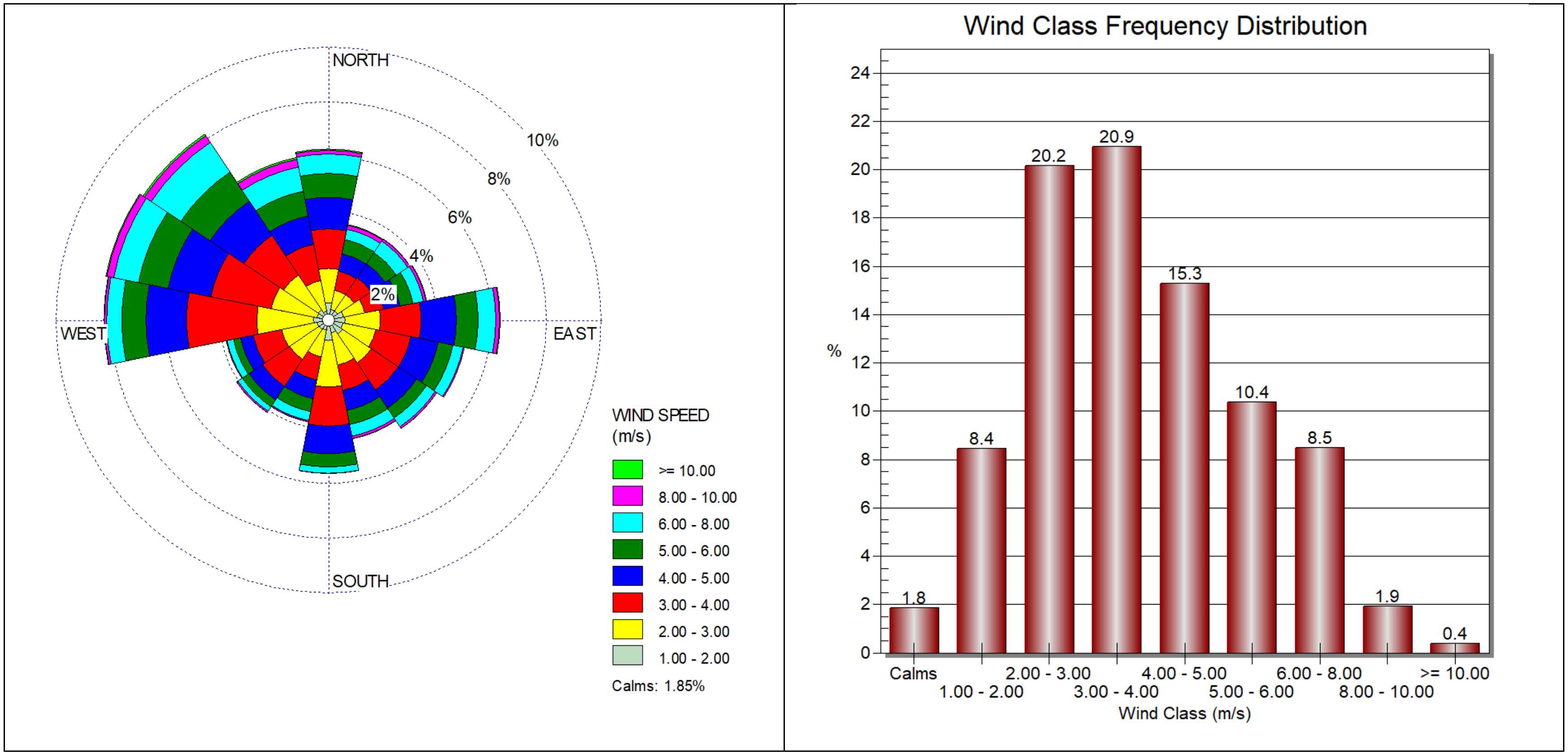
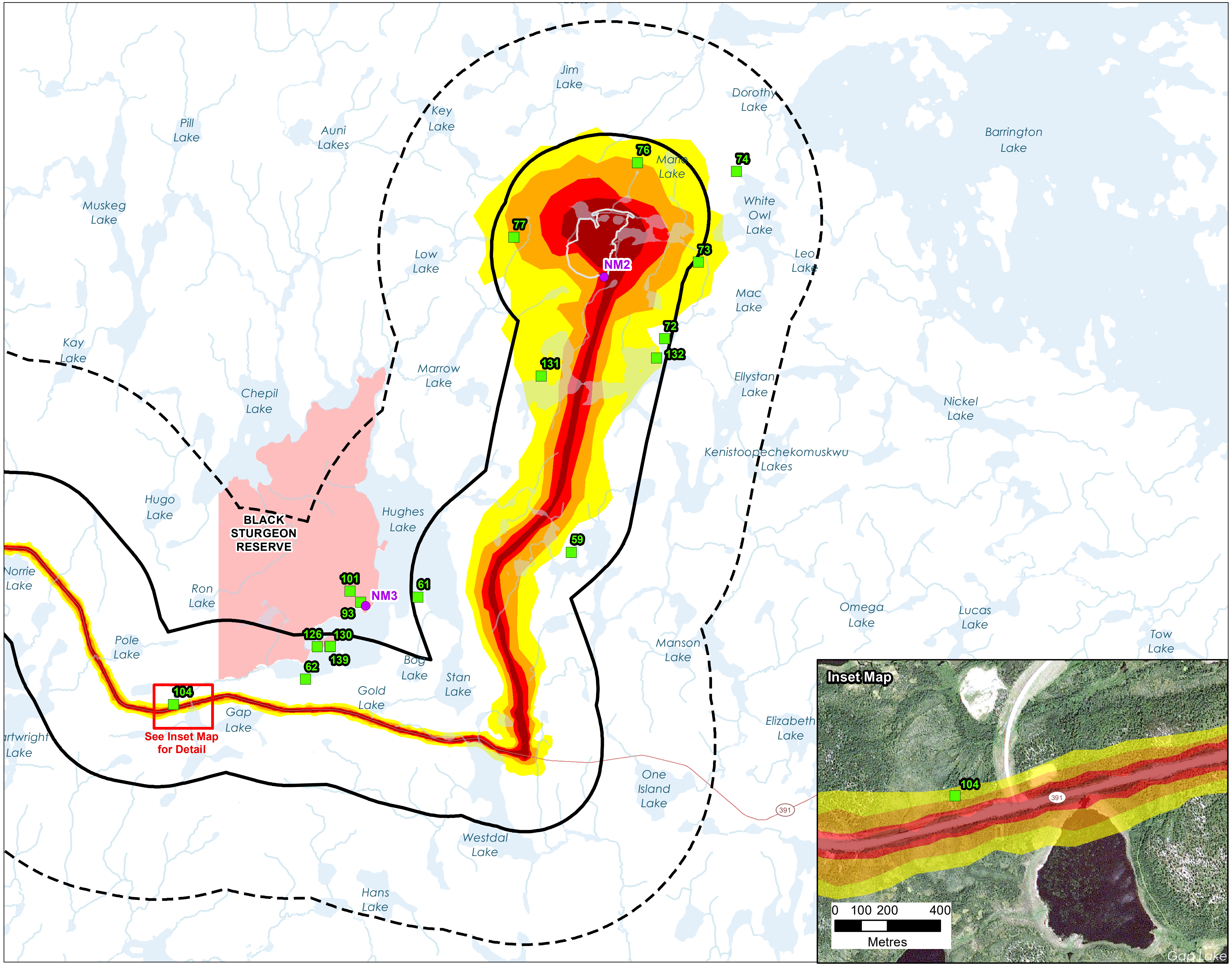


Figure IAAC-127-2 Wind Rose and Wind Frequency Distribution Diagram at Lynn Lake Airport, Manitoba (2015-2018)

A.31 ATTACHMENT IAAC-132



Stantec

Alamos Gold Inc.

Study Area

- ☐ Project Development Area at Mine Site
- ☐ Noise and Vibration Local Assessment Area (LAA)
- ☐ Noise and Vibration Regional Assessment Area (RAA)

Locations

- ● Noise Monitoring Location
- 🟩 Receptor Location

Noise Level (dBA)

- 🟥 >40 dBA
- 🟥 >35 dBA
- 🟧 >30 dBA
- 🟨 >25 dBA

Landbase

- Highway
- Watercourse
- Waterbody
- First Nation Reserve

N

0 2 4 Kilometres

(At original document size of 11x17)
1:105,000

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada.
3. Imagery: SPOT-7 imagery, BlackBridge Geomatics, July 2015.

Project Location
Lynn Lake,
Manitoba

Prepared by ACampigotto on 2021-05-04
Technical Review by SZabani on 2021-05-04

Client/Project
111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
3

DRAFT

Title

Construction Phase Noise Contours - Gordon Site

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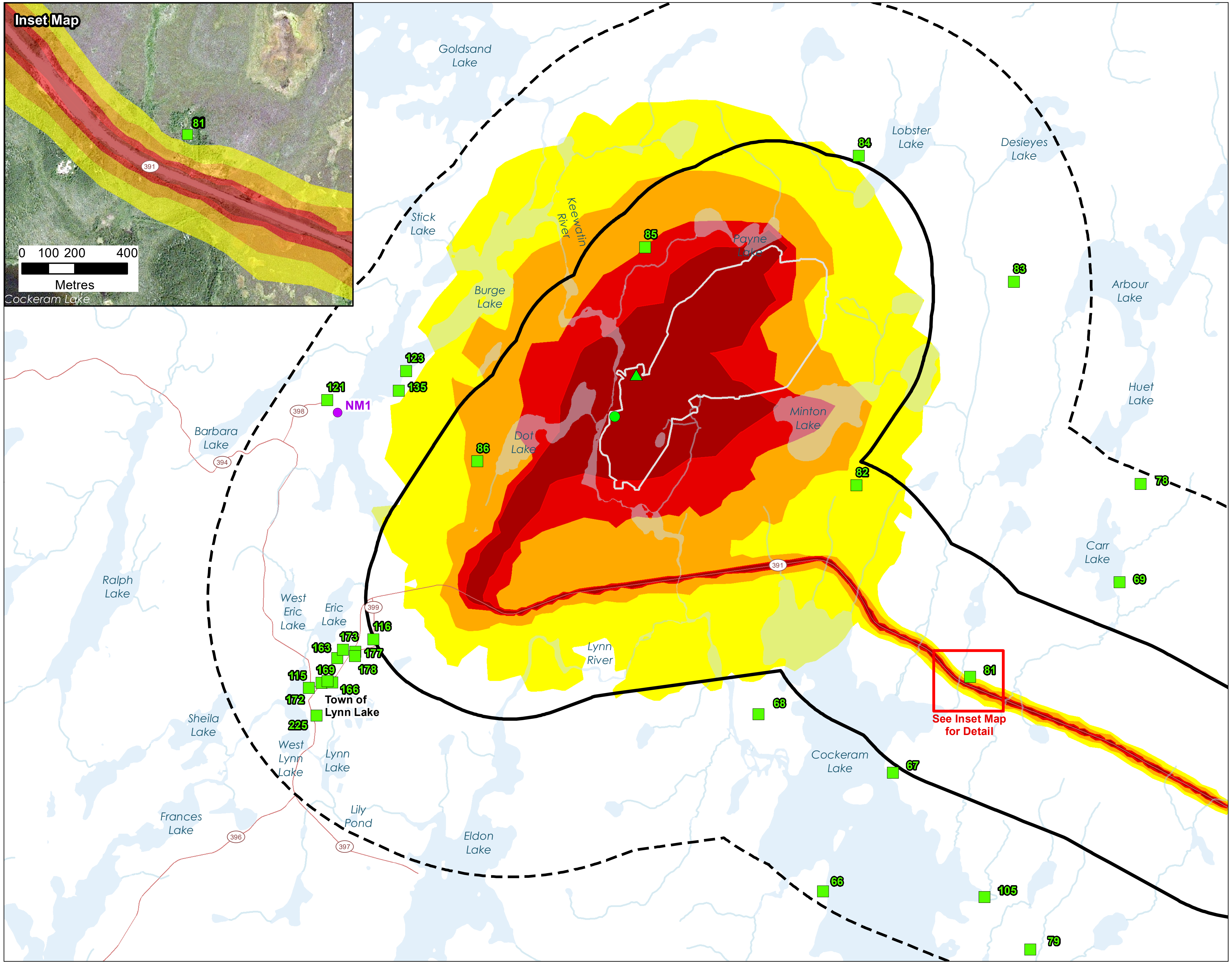

Study Area

- ⬜ Project Development Area at Mine
- ▭ Noise and Vibration Local Assessment Area (LAA)
- ⬚ Noise and Vibration Regional Assessment Area (RAA)

Locations

- ● Noise Monitoring Location
- 🟩 Receptor Location
- ▲ Future Worker Camp
- ● Temporary Worker Camp

Noise Level (dBA)

- 🟥 >40 dBA
- 🟥 >35 dBA
- 🟧 >30 dBA
- 🟨 >25 dBA

Landbase

- — Highway
- — Watercourse
- ▭ Waterbody

N

0 1 2 Kilometres
(At original document size of 11x17)
1:75,000

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada.
3. Imagery: SPOT-7 imagery, BlackBridge Geomatics, July 2015.

Project Location
Lynn Lake,
Manitoba

Prepared by ACampigotto on 2021-05-03
Technical Review by SZabani on 2021-05-03

Client/Project
ALAMOS GOLD INC.
Lynn Lake Gold Project

111473012

Map No.
4

DRAFT

Title

Construction Phase Noise Contours - MacLellan Site

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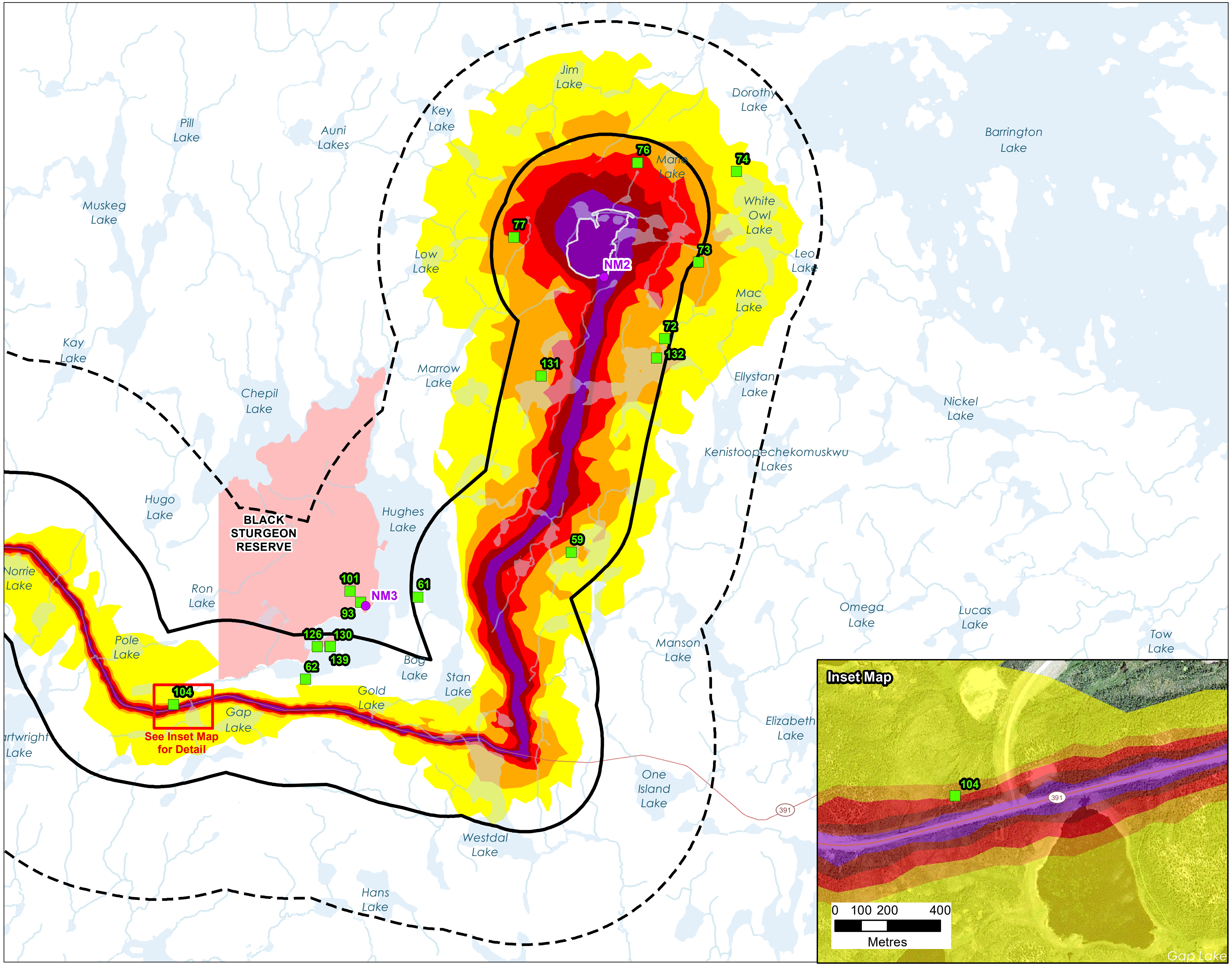

Stantec

Alamos Gold Inc.

Study Area

- ☐ Project Development Area at Mine Site
- ▭ Noise and Vibration Local Assessment Area (LAA)
- ⬚ Noise and Vibration Regional Assessment Area (RAA)

Locations

- ● Noise Monitoring Location
- 🟩 Receptor Location

Noise Level (dBA)

- 🟪 >45 dBA
- 🟥 >40 dBA
- 🟥 >35 dBA
- 🟧 >30 dBA
- 🟨 >25 dBA

Landbase

- — Highway
- — Watercourse
- ▭ Waterbody
- ▭ First Nation Reserve

N

0 2 4 Kilometres

(At original document size of 11x17)
1:105,000

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada.
3. Imagery: SPOT-7 imagery, BlackBridge Geomatics, July 2015.

Project Location
Lynn Lake,
Manitoba

Prepared by ACampigotto on 2021-05-05
Technical Review by SZabani on 2021-05-05

Client/Project
111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
5

DRAFT

Title

Operation Phase Noise Contours - Gordon Site

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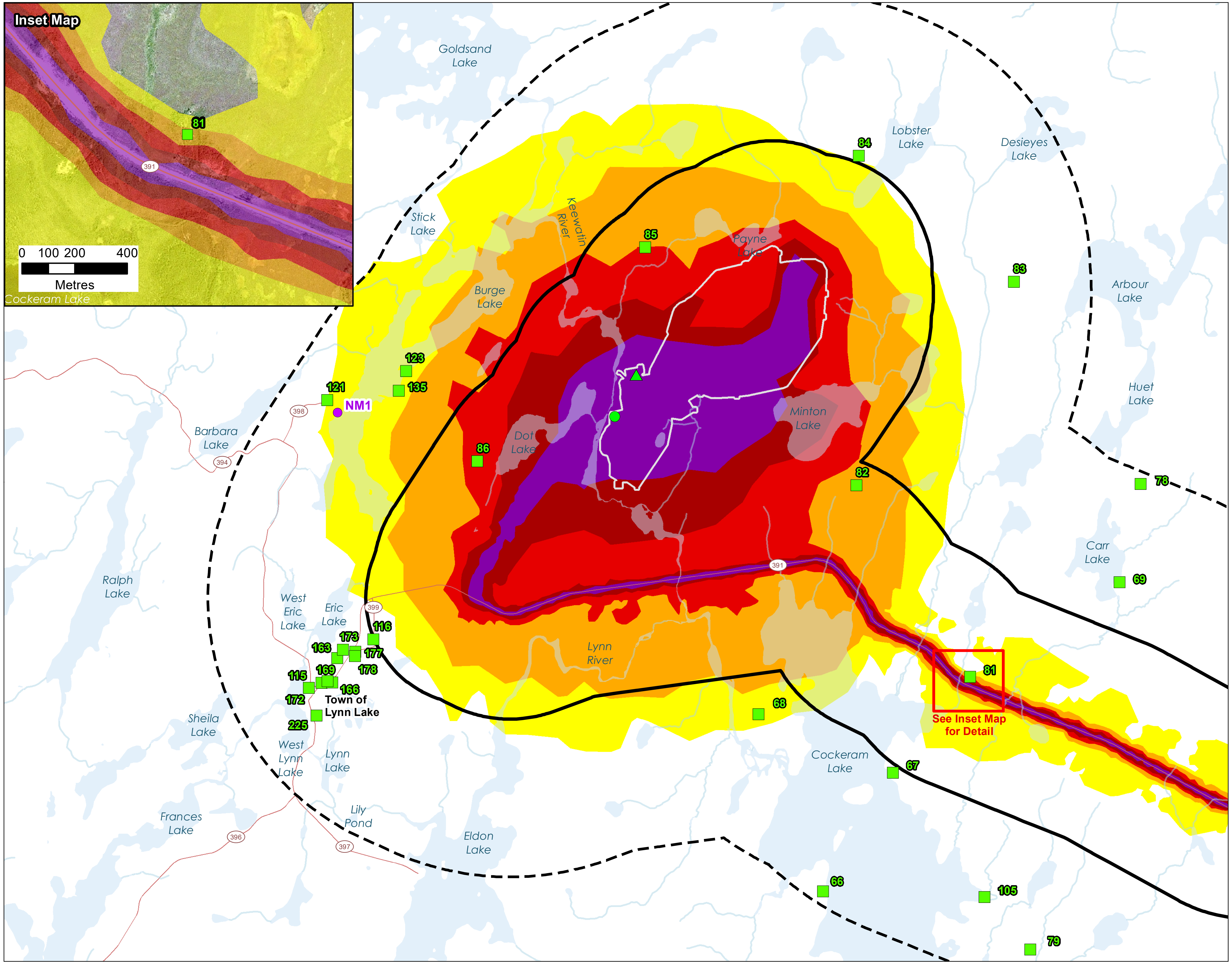

Stantec

Alamos Gold Inc.

Study Area

☐ Project Development Area at Mine Site

☐ Noise and Vibration Local Assessment Area (LAA)

⬚ Noise and Vibration Regional Assessment Area (RAA)

Locations

● Noise Monitoring Location

🟩 Receptor Location

▲ Future Worker Camp

● Temporary Worker Camp

Noise Level (dBA)

🟪 >45 dBA

🟥 >40 dBA

🟥 >35 dBA

🟧 >30 dBA

🟨 >25 dBA

Landbase

— Highway

— Watercourse

▭ Waterbody

N

0 1 2 Kilometres

(At original document size of 11x17)
1:75,000

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N

2. Base Data Sources: Government of Manitoba and Government of Canada.

3. Imagery: SPOT-7 imagery, BlackBridge Geomatics, July 2015.

Project Location
Lynn Lake,
Manitoba

Prepared by ACampigotto on 2021-05-03
Technical Review by SZabani on 2021-05-03

Client/Project
ALAMOS GOLD INC.
Lynn Lake Gold Project

111473012

Map No.
6

DRAFT

Title
Operation Phase Noise Contours - MacLellan Site

G:_GIS_Project_Folder\111473008_LLGP_EA\IRs\Noise\Map6_NOISE_MacLellanOperationalNoiseContour_20210504.mxd Revised: 2021-05-04 By: ACampigotto

A.32 ATTACHMENT IAAC-144

Stantec

Lynn Lake Gold Project – Fate and Behavior Modelling of Hazardous Materials Spill

Final Report

Prepared for:

Alamos Gold Inc
10 King Street East, Suite 501
Toronto, ON M5C 1C3

Prepared by:

Stantec Consulting Ltd.
300W-675 Cochrane Drive
Markham, ON L3R 0B8

File No: 111473012

LYNN LAKE GOLD PROJECT – FATE AND BEHAVIOR MODELLING OF HAZARDOUS MATERIALS SPILL

This document entitled Lynn lake Gold Project – Fate and Behavior Modelling of Hazardous Materials Spill was prepared by Stantec Consulting Ltd. ("Stantec") for the account of Alamos Gold Inc (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

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Sheldon Smith, MES, P.Geo.
Principal, Senior Hydrologist

Table of Contents

LIST OF TABLES

LIST OF FIGURES

Abbreviations

2D	two-dimensional
CCME	Canadian Council of Ministers of the Environment
DARM	Drainage Area Ratio Method
EC	Environment Canada
ECCC	Environment and Climate Change Canada
EIS	Environmental Impact Statement
FM	Flexible Mesh
ICMC	International Cyanide Management Code
MDMER	Metal and Diamond Mining Effluent Regulation
PT	Particle Tracking
the Project	Lynn Lake Gold Project
WSC	Water Survey of Canada
MRSA	Mine Rock Storage Area
TMF	Tailings Management Facility
AN	Ammonium Nitrate
ANFO	Ammonium Nitrate Fuel Oil
CWQG -FAL	Canadian Water Quality Guidelines – Freshwater Aquatic Life
MAD	Mean Annual Discharge

1.0 INTRODUCTION

The Lynn Lake Gold Project consists of construction (redevelopment), operation and eventually closure and reclamation of an open pit gold mine at two deposit sites, the 'Gordon' site and the 'MacLellan' site, which are respectively located 55 km east and 8 km northeast of the town of Lynn Lake, Manitoba.

Operational activities at both sites will include conventional open pit mining with shovel and truck removal of the mine rock and ore produced during blasting. Infrastructure at the MacLellan site will include an open pit, a central ore milling and processing plant, ore and overburden stockpiles, a mine rock storage area (MRSA), and a Tailings Management Facility (TMF).

Infrastructure at the Gordon site will be limited to an open pit, ore and overburden stockpiles, an MRSA, and minor supporting infrastructure for equipment fueling, storage and maintenance. The run-of-mine ore from the Gordon site will be transported via trucks to the MacLellan site for short-term storage and initial crushing before it is used as feedstock for the adjacent ore milling and processing plant. There will be no milling or tailings produced at the Gordon site.

An Environmental Impact Statement (EIS) for the Project was prepared and submitted to the Impact Assessment Agency of Canada (the Agency) by Alamos Gold Inc. (Alamos) on May 25, 2020. The Agency provided Information Requests (IRs) for the EIS on December 22, 2020, including IR 144, which requested that fate and behavior modelling of potential spills of hydrocarbons, sodium cyanide, and ammonium nitrate to fish-bearing waterways across all seasons be conducted.

The potential effects of Project-related spills are described in Volume 3, Chapter 22 of the EIS. In response to IR 144, the following report evaluates the fate and behaviour of potential major spills of hydrocarbons, sodium cyanide, and ammonium nitrate into the Keewatin river, flowing into the Lynn River and then into Cockeram Lake for the MacLellan site. For the Gordon site, this study evaluates the fate and behaviour of potential spills of hydrocarbon, and ammonium nitrate into the Hughes River, which flows into Wetikoeekan Lake. For hydrocarbons, diesel was selected as the most common hydrocarbon to be delivered to the Project site via tanker truck. Sodium cyanide is the formulation that cyanide, used in gold extraction from host ore, will be delivered to the Project Site. Ammonium nitrate is used in the manufacture of ammonium nitrate emulsion explosives. All three classes of hazardous materials will be delivered to the MacLellan site and will cross the Keewatin River. However, as milling and the manufacture of explosive emulsion will only occur at the MacLellan site, it was assumed only diesel and ammonium nitrate emulsion would be transported between the MacLellan and Gordon site and thus cross the Hughes River. This report focuses on the worst case scenario locations for a spill, and does not include spills of smaller magnitude or at other locations (e.g., on land).

Spills of sodium cyanide or ammonium nitrate are considered to be less likely as these substances are transported in solid form and shipments are less frequent. As such, in the unlikely event of a spill of these solids, it would be expected that the spilled material could be cleaned up and removed from the spill site without entering a watercourse. The worst probable case for a hazardous material spill would likely be a spill of petroleum hydrocarbons into the Hughes River at the Gordon site or the Keewatin River at the

MacLellan site during the winter and summer low flows. Given the general floating characteristics, the petroleum hydrocarbons would be transported downstream into connecting waterbodies and to riparian areas. Some fuel constituents are hydrophobic and would likely move from the water to the sediment environment.

In the unlikely event of a major industrial accident or malfunction involving a large-scale release into the environment (e.g., spill from vehicle malfunction or collision into a waterbody), there is a potential for significant residual adverse effects. However, mitigation and conformity with industry standards (e.g., emergency response and contingency planning) make a significant effect unlikely to occur. Alamos will develop contingency planning and implement engineering and quality controls during the design, construction, and operational phases to mitigate adverse environmental effects. Alamos will design critical components of mine infrastructure to relevant design codes and criteria so that risk falls within acceptable ranges for lifecycle performance.

2.0 SPILL STUDY AREA

The Lynn Lake Gold Project consists of two sites, the MacLellan site and the Gordon site located in northwestern Manitoba (Chapter 1, Map 1-1). Both sites are located at historical mine sites. The Project includes the development of new mine infrastructure at the MacLellan site, including an open pit, central ore milling and processing plant, associated infrastructure, ore and overburden stockpiles, a mine rock storage area (MRSA), and a Tailings Management Facility (TMF). New infrastructure at the Gordon site will be limited to an open pit, ore and overburden stockpiles, a MRSA, and minor supporting infrastructure for equipment fueling, storage and maintenance. There will be no tailings storage or milling at the Gordon site.

The MacLellan site is located 8 km (by vehicle) northeast of the town of Lynn Lake (14U 380900E 6307500N) and the Gordon site is located 55 km (by vehicle) east of Lynn Lake (14U 412400E 6307800N). The distance between the MacLellan and Gordon sites is approximately 30 km (57 km by vehicle). Lynn Lake is located approximately 820 km (1,083 km by vehicle) northwest of Winnipeg. The proposed preliminary layouts for the redeveloped Gordon and MacLellan sites are shown on Figure 2-1.

As per Chapter 22 of the EIS, "The worst probable case for a hazardous material spill would likely be a spill of petroleum hydrocarbons into the Hughes River at the Gordon site or the Keewatin River at the MacLellan site during the winter and summer low flows. Given the general floating characteristics, the petroleum hydrocarbons would be transported downstream into connecting waterbodies and to riparian areas. Some fuel constituents are hydrophobic and would likely move from the water to the sediment environment."

The most common hydrocarbon used at the Project sites will be diesel which will be delivered by tanker truck to site on a year-round basis on semi-tractor/tanks with maximum capacity up to 43,900 L. Sodium cyanide is the primary gold leaching agent. It will be delivered to the mine site in briquette form and is most typically shipped in 50 kg drums or 100 kg plywood boxes in 18 tonne isotainer shipments. Cyanide transport will be in accordance with the International Cyanide management Code (ICMC) for the gold mining industry. Ammonium Nitrate is the primary component of ANFO (Ammonium Nitrate Fuel Oil) and ammonium nitrate emulsion explosives with the latter considered the primary explosive used at the mine site. The ammonium nitrate (AN) will be shipped in prill/flaked (solid) form, in 1000 kg bags in shipping containers. The accidental spill fate and behavior modeling will consider a spill of diesel from a semi-tractor tanker truck, sodium cyanide from an 18-tonne isotainer delivery truck and ammonium nitrate from an intermodal shipping container. The ammonium nitrate form will be different at the MacLellan site Keewatin River crossing than for the Gordon site Hughes River crossing. AN crossing the Keewatin River will be delivered in prill/flaked solid form, however assuming that the emulsion explosive will be manufactured at the MacLellan site, only an ammonium nitrate emulsion will be transported to the Gordon site and cross the Hughes River. It is assumed the emulsion will be transported in 275 Gallon IBC totes.

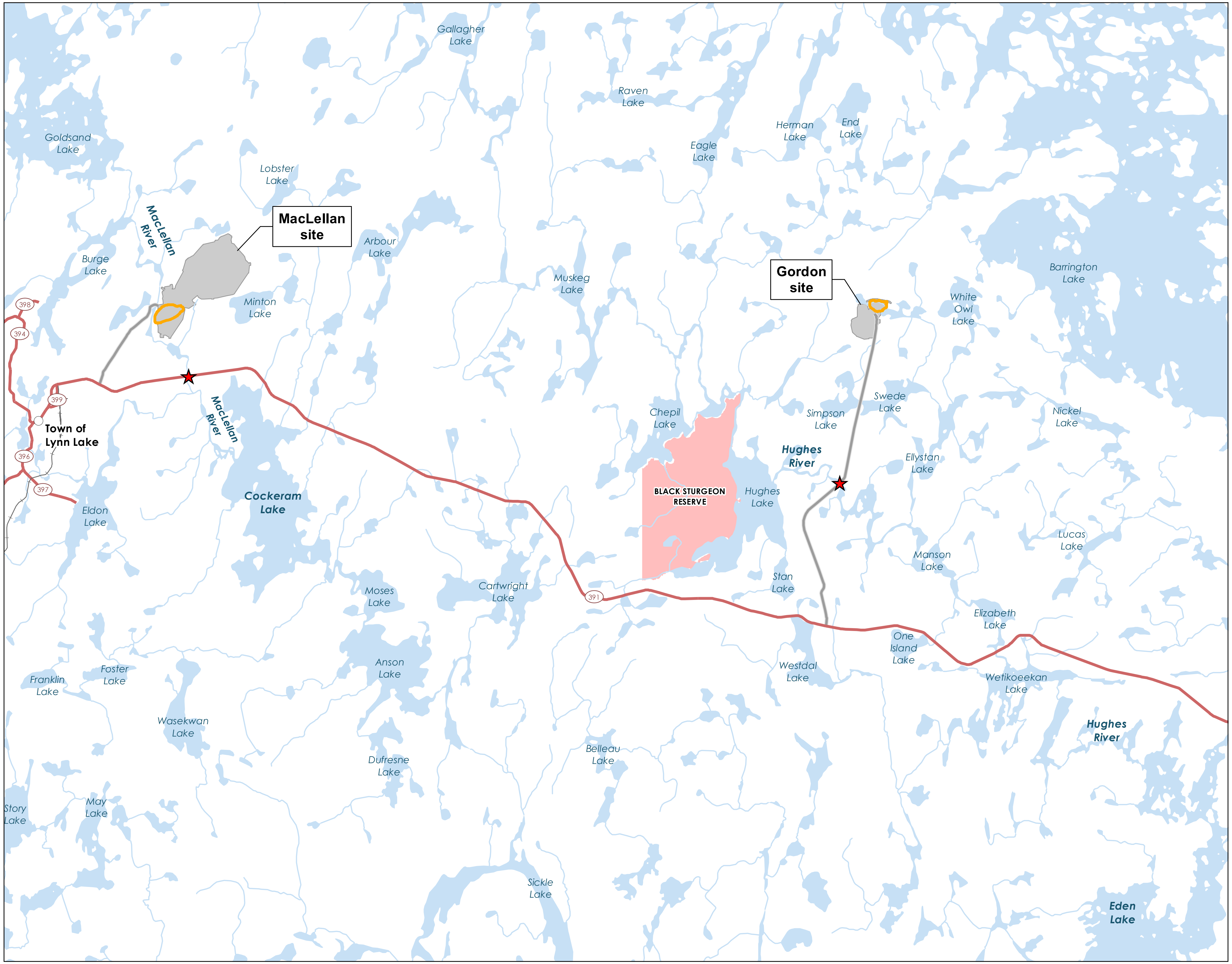
Two potential spill locations have been identified:

- The MacLellan site located in the Keewatin River watershed
- The Gordon site located in the Hughes River watershed

Both these two rivers ultimately drain into Granville Lake. Since the downstream spill study area is large, the following approach was implemented to increase modeling efficiency and execution time:

- The downstream boundary of the model domain for spills into the Hughes River will be limited to Wetikoeekan Lake. It is assumed that ambient water quality conditions in Wetikoeekan Lake will return to baseline conditions or Canadian Water Quality Guidelines – Freshwater Aquatic Life (CWQG -FAL) thresholds at the Lake outlet boundary.
- The downstream boundary of the model domain for spills into the Keewatin River will be limited to Cockeram Lake. It is assumed that ambient water quality conditions in Cockeram Lake will return to baseline conditions or CWQG -FAL thresholds at the Lake outlet boundary.

A two-dimensional (2D) hydrodynamic model was built using MIKE 21 Flow Model Flexible Mesh (FM). MIKE 21 FM is a powerful commercial 2D hydrodynamic model developed by the Danish Hydraulic Institute (DHI). Monitored data within the lakes will be used to estimate low, average, and high-water levels in the lakes. Available regional hydrology assessments and regressions will be used to estimate flows in the rivers.



Stantec

Project Infrastructure

▭ Proposed Open Pit
▨ Project Development Area

Potential Spill Location

★ Outlet Points to Main Rivers

Landbase

— Highway
— Access Road
—+— Rail
— Watercourse
▨ Waterbody
▨ First Nation Reserve

N

0 3 6 Kilometres

(At original document size of 11x17)
1:175,000

Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada

Project Location
Lynn Lake,
Manitoba

Prepared by ACampigotto on 2021-06-14
Technical Review by DThapa on 2021-06-14

Client/Project 111473012

ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
1

DRAFT

Title

Study Area

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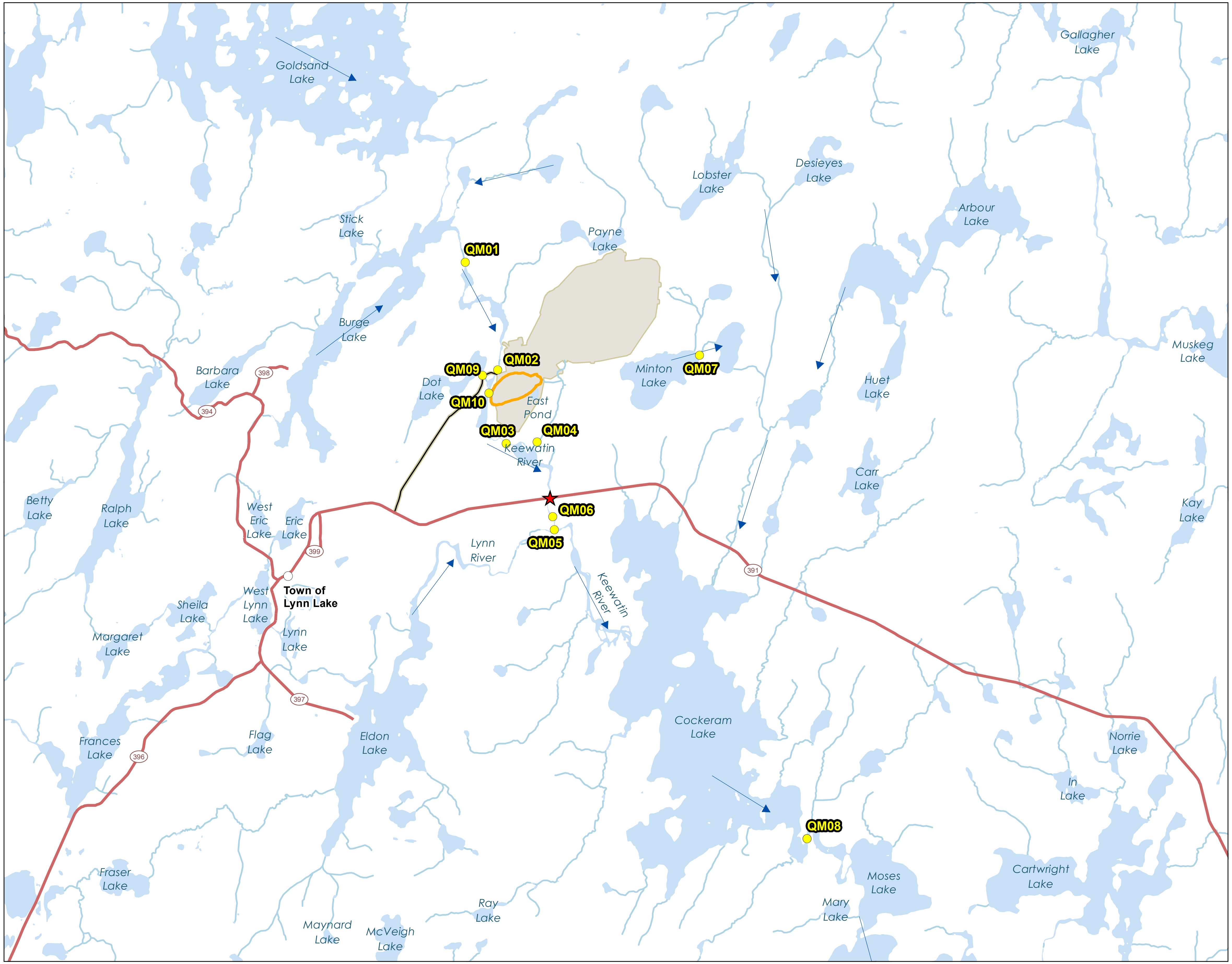
3.0 AMBIENT CHARACTERIZATION

3.1 AMBIENT WATER QUANTITY

Hydrometric records from the WSC Historical Data and Station Information were used for this study area. Hydrometric stations were selected if they were located within an approximate 200 km radius of either site to reduce differences in precipitation patterns and geophysical features within the watersheds directly affected by the Project. Only regional gauging stations with at least 10 years of data were used in the assessment. Five hydrometric stations in the region of northwestern Manitoba and northeastern Saskatchewan met the necessary criteria (Table 3-1). There are no long-term river gauging stations located along the main rivers area surrounding the MacLellan or Gordon sites. Therefore, local hydrometric monitoring stations were set up within the Project area to obtain water level data at selected lakes and watercourses. The locations of the stations were determined during the initial field reconnaissance in 2015 and are shown in Figure 3-1 and Figure 3-2 as well as Table 3-2 and Table 3-2 (Stantec, 2017c).

Table 3-1 Summary of the Regional Hydrometric Stations

Station ID	Name	Status	Province	Period of Record	Drainage area (km^2)
06DA002	Cochrane River near Brochet	Active	MB	1968-2015	28,400
06FA001	Gauer River below Thorsteinson Lake	Active	MB	1979-2015	5,970
06EB003	Barrington River above First Rapids	Discontinued	MB	1974-1991	1,760
06EA007	Pagato River at Outlet of Pagato Lake	Discontinued	SK	1973-1995	961
05TF002	Footprint River above Footprint Lake	Active	MB	1977-2016	643



Stantec

Site Locations

★ Outlet Points to Main River

● Hydrology Monitoring Station

→ Surface Water Flow Direction

Project Infrastructure

▭ Proposed Open Pit

▨ Project Development Area

Landbase

— Existing Access Road

— Highway

— Watercourse

▨ Waterbody

N

0 1.5 3 Kilometres

(At original document size of 11x17)
1:100,000

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada.

Project Location
Lynn Lake,
Manitoba

Prepared by ACampigotto on 2021-06-28
Technical Review by DThapa on 2021-06-28

Client/Project
111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
3

DRAFT

Title
Location map of MacLellan sites

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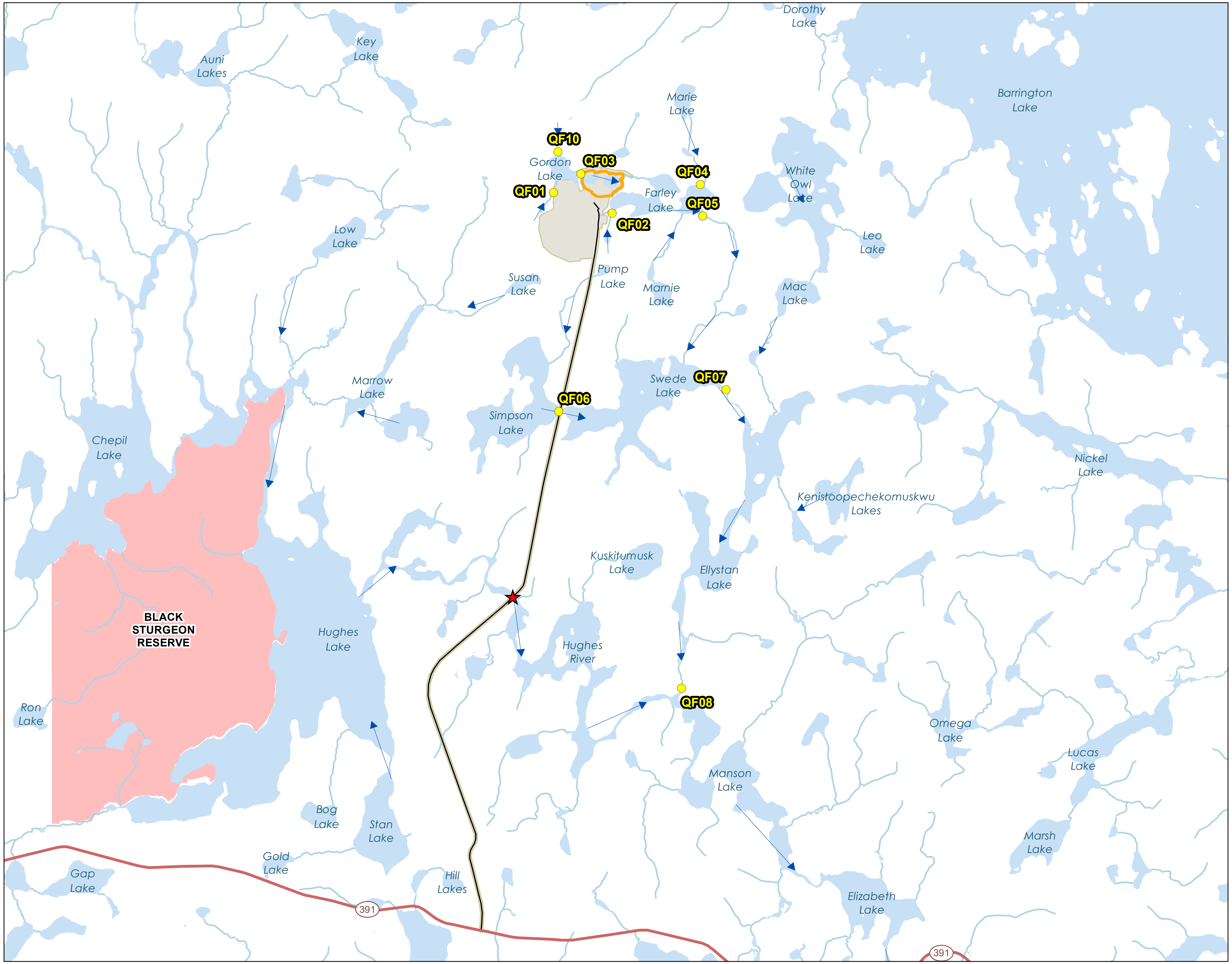

Stantec

Site Locations

★ Outlet Points to Main River
● Hydrology Monitoring Station
→ Surface Water Flow Direction

Project Infrastructure

▭ Proposed Open Pit
▨ Project Development Area

Landbase

— Existing Access Road
— Highway
— Watercourse
▨ Waterbody
▨ First Nation Reserve

N

0 1 2 Kilometres
(At original document size of 11x17)
1:75,000

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base Data Sources: Government of Manitoba and Government of Canada.

Project Location
Lynn Lake,
Manitoba

Prepared by ACampigotto on 2021-06-28
Technical Review by DThapa on 2021-06-28

Client/Project
111473012
ALAMOS GOLD INC.
Lynn Lake Gold Project

Map No.
2

DRAFT

Title
Location map of Gordon sites

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Table 3-2 MacLellan Hydrometric Monitoring Stations

Station ID	UTM Coordinates (Zone 14V)	Period of operation	Monitored parameters	Drainage Area (Km^2)	% Lakes	Description
QM01	379675 E 6310698 N	May 26, 2015 - present	Water Level, EC, T	1,310 .1	23	Keewatin River, upstream of the potential PDA.
QM02	380500 E 6307978 N	May 24, 2015 - May 5, 2016	None	1,323.30	22.9	Keewatin River, immediately upstream of the proposed open pit. Superseded by QM10 in May 2016.
QM03	380709 E 6306104 N	May 25, 2015 - present	Water Level, EC, T	1,333.70	22.8	Keewatin River, immediately downstream of the proposed open pit.
QM04	381507 E 6306154 N	May 25, 2015 - present	Water Level, EC, T	5	1	Unnamed tributary to the Keewatin River, downstream of QM03. This station measures runoff from the potential PDA.
QM05	381934 E 6303916 N	June 1, 2015 - present	Water Level, EC, T	470.4	10	Lynn River, above the confluence with the Keewatin River. The objective of this station is to measure flows into Cockeram Lake that are not influenced by the Project or the Keewatin River.
QM06	381889 E 6304247 N	May 27, 2015 - present	Water Level, EC, T	1,344.80	22.7	Keewatin River, downstream of the potential PDA and upstream of the confluence with the Lynn River. The objective of this station is to measure flows into Cockeram Lake that may be influenced by the Project.
QM07	385615 E 6308333 N	May 26, 2015 - present	Water Level, EC, T	12.4	13.3	Minton Lake. Lake is closed (no surface water outlets), so the station measures lake level only.
QM08	388377 E 6296094 N	May 31, 2015 - present	Water Level, EC, T	2,004.50	19.1	Outlet at the south end of Cockeram Lake, downstream of the potential PDA.
QM09	380118 E 6307832 N	May 24, 2015 - present	Water Level, EC, T	7.5	14.1	Outlet of Dot Lake, tributary to the Keewatin River downstream of QM02, near the proposed open pit.
QM010	380282 E 6307378 N	May 5, 2016 - present	Water Level, EC, T	1,330.00	22.9	Keewatin River, adjacent to the proposed open pit. The station is 630 m downstream of QM02.
EC – Electrical Conductivity; T – Water Temperature; PDA – Project Development Area						

Table 3-3 Gordon Hydrometric Monitoring Stations

Station ID	UTM Coordinates (Zone 14V)	Period of operation	Monitored parameters	Drainage Area (Km^2)	% Lakes	Description
QF01	411478 E 6307677 N	May 29, 2015 - present	Water Level, EC, T	1.5	0.7	Inlet to Gordon Lake. The objective of this station is to measure flow into Gordon Lake from the south, on the west side of the potential PDA.
QF02	411478 E 6307677 N	May 30, 2015 - May 7, 2016	Water Level, EC, T	1.1	0.9	Inlet to Farley Lake from the southwest, on the east side of the potential PDA. Moved upstream in May 2016.
QF02b	412595 E 6307280 N	May 7, 2016 - present	Water Level, EC, T	1.1	0.9	New location for QF02, 50 m upstream of its previous location.
QF03	411995 E 6308030 N	May 29, 2015 - present	Water Level, EC, T	4.3	4.4	Gordon Lake. This station is intended to measure outflows from Gordon Lake into the diversion to Farley Lake.
QF04	414243 E 6307786 N	May 28, 2015 – May 7, 2016	Water Level, EC, T	1.5	14.0	Inlet to Farley Lake from the north, downstream of Marie Lake. The objective of this station is to measure flow into Farley Lake from the watershed to the north, which is expected to be unaffected by site infrastructure. Moved upstream in May 2016.
QF04b	414270 E 6307825 N	May 7, 2016	Water Level, EC, T	1.5	14.0	New location for QF04, 50 m upstream of its previous location.
QF05	14317 E 6307228 N	May 28, 2015 - present	Water Level, EC, T	13.3	9.3	Outlet of Farley Lake, to the east. The objective of this station is to measure outflows from Farley Lake.
QF06	411577 E 6303510 N	May 30, 2015 - present	Water Level, EC, T	8.0	21.9	Outlet of Simpson Lake into Swede Lake. Flows are measured downstream of the culvert connecting the two lakes.
EC – Electrical Conductivity; T – Water Temperature; PDA – Project Development Area						

3.1.1 Seasonality

The Gordon and MacLellan sites are located in the Churchill River Upland Ecoregion and Reindeer Lake Ecodistrict (Smith et al. 1998). The historical climate data gathered from the ECCC Lynn Lake climate stations are representative of this area, exhibiting cool, short summers and cold, long winters (Stantec,2017a). A hydrology field program was conducted from March 2015 to October 2016. The program included (Stantec, 2017b):

- Snow surveys to document the depth snow on ground at each site.
- Reconnaissance survey to confirm locations for the installations of level loggers for flow.
- Monitoring eighteen stations chosen, 10 for MacLellan site (Table 3-1) and 8 for Gordon site (Table 3-2).
- Initial elevation measurements taken at each of the eighteen stations.
- Initial streamflow measurements taken at each of the eighteen stations.
- Subsequent elevation and streamflow measurements taken at each of the eighteen stations.
- Downloading data from level loggers at each of the eighteen stations.
- Bathymetric surveys at Dot Lake, Minton Lake, Keewatin River, Gordon Lake, Farley Lake, and East Pit.
- Adjustment of hydrometric station locations to account for changing conditions and data objectives
- Elevation and streamflow measurements taken at each of the eighteen stations.

Results from the two years of surveys indicate that the highest flows typically occur during the spring period in response to snowmelt in the Project area. Peak flow sometimes occurs later in the melt season in response to rainfall events. In the 2016 water year, the highest recorded flow was 26.7 m3/s at QM08 on July 16, 2016. The lowest recorded flows occurred during the late winter, prior to the onset of spring snowmelt.

3.1.2 MacLellan Site Spill Water Quantity Inputs

The mean annual discharge (MAD), 7Q10 (a 7-day 10-year return period low flow event) and peak flows such as the 2-, 10-, 20-, and 100-year return period events were calculated for the regional hydrometric stations (Table 3-1). Three flow conditions (MAD, 7Q10 and Q20) are used to characterize the range of hydrological conditions experienced in all seasons. The regression equations developed by using the regional hydrometric stations were used to estimate the peak flow at three local hydrometric stations (Table 3-3). The input parameter used in the regression equation was drainage area (Stantec, 2017d). The watershed area of the watercourse flowing into the lake is 2004.5 km^2.

Table 3-4 Local Mean Annual Discharge and Peak Flow Analysis

Station ID	Drainage Area (Km^2)	Mean Annual Discharge (m^3/s)	Annual 7 day 10-year Return Period (7Q10) Low Flow (m^3/s)	Peak Flow (m^3/s)			
				2-year	10-year	20-year	100-year
				$Q=0.031A^{0.90}$	$Q=0.11A^{0.80}$	$Q=0.16A^{0.77}$	$Q=0.32A^{0.71}$
QM01	1,310	7.4	0.66	19.3	33.5	39.2	52.6
QM05	470	2.7	0.13	7.7	14.8	17.8	25.4
QM06	1,344	7.6	0.69	19.8	34.2	40.0	53.6

3.1.3 Cockeram Lake Water Levels

The Cockeram Lake outlet is a low gradient channel with irregular side slopes and contains boulders, shrubs, and conifers on the bank. The local hydrometric station (QM08) is located at the outlet of the south end of Cockeram Lake. Data from this hydrometric station was available from May 31, 2015 to May 30, 2019 and was analysed. Figure 3-3 shows the observed mean monthly, maximum, and minimum daily water levels at outlet of the Cockeram Lake. The water levels varied between 312.02 meters above mean sea level (masl) and 312.65 masl, with an average water level of 312.20 masl. Following the spring snowmelt, the maximum water levels occur in May and June.

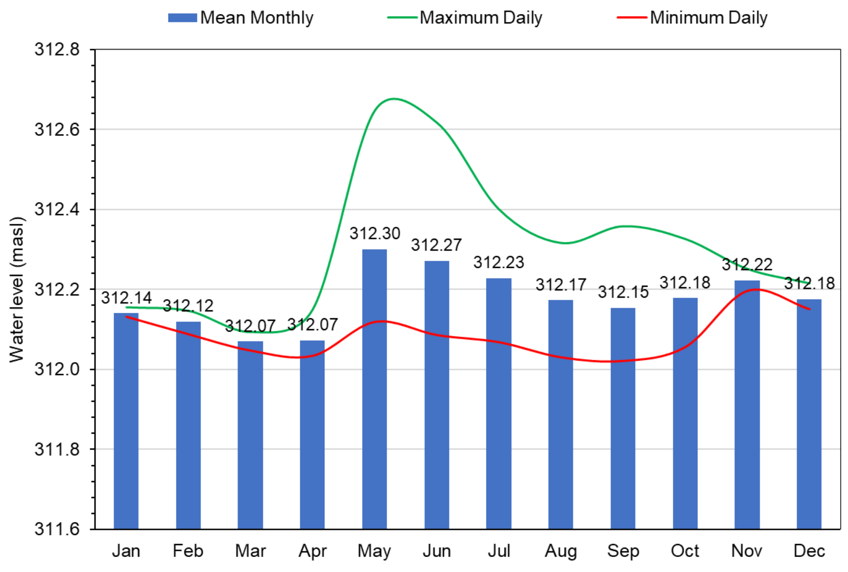


Figure 3-3 Mean Monthly and Maximum and Minimum Daily Water Levels at Station QM08 Located at the Outlet Cockeram Lake

3.1.4 River Hydrology – MacLellan Site

The MacLellan study area includes the Keewatin River and Lynn River. The run-off from the MacLellan site enters the Keewatin River via a stream that drains a small pond (East Pond) to the south and several smaller tributaries that drain to the west. The East Pond was the main water collection area for the historical MacLellan Mine. The Lynn River drains into the Keewatin River downstream of the MacLellan Mine. The combined run-off from the Keewatin and Lynn Rivers drains into Cockeram Lake. Provincial Road (PR) 391) crosses the Keewatin river which is a possible spill area. Figure 3-1 shows the spill location, which is approximately 0.85 km north (upstream) of the confluence of the Keewatin and Lynn Rivers.

3.1.5 Gordon Site Spill Water Quantity Inputs

The regional regression equations developed for the project were used to estimate low (7Q10), MAD, and high flows (Q20) in the Hughes River at the spill location (Figure 2-2). The input parameter used in the regression equation was drainage area. The watershed area at the spill location (Figure 3-2) of the Hughes River is 3159.6 km^2. The estimated 20-year return period flow (Q20), MAD and 7Q10 flow were 79.22 m^3/s, 17.76 m^3/s and 2.72 m^3/s respectively (Stantec, 2017d).

3.1.6 Wetikoeekan Lake Water Levels

Historical water level data for Wetikoeekan Lake are not available. Therefore, an average lake depth of 2 m was assumed based on the lowest depths observed in adjacent lakes as a conservative assumption. Lake level variations were defined by using the lake level variations of Cockeram Lake (63 cm). The average level of Wetikoeekan Lake was assumed 278.74 m which is two (2) m higher than the average level of the lake's bed. Similarly, maximum, and minimum levels were adopted, 278.92 m and 278.29 m respectively, which are 0.18 m higher and 0.45 m lower than the average level. Due to the unavailability of the Wetikoeekan lake historical water level, these reference values (0.18 m and 0.45 m) were taken from Cockeram Lake water level for maximum and minimum flow. These values represent the difference between the maximum and average water levels in the high flow (Q20) condition, as well as the average and minimum flow in the low flow (7Q10) condition.

3.1.7 River Hydrology – Gordon Site

The Gordon study area includes several small sub-watersheds that drain into Gordon Lake and Farley Lake (Marie and Marnie lakes, several unnamed lakes, and ponds). Water flows eastward from Gordon Lake into Farley Lake through a diversion channel. Farley Lake drains southward via Farley Creek into the eastern end of Swede Lake, which flows into the north end of Ellystan Lake (Figure 2-2). This flow ultimately drains into the Hughes River, via Swede and Ellystan lakes, which in turn discharges into Wetikoeekan Lake.

The outflow from the Hughes Lake drains to the Hughes River. The service road connected to the PR 391 crosses the Hughes river which is a possible spill area. Figure 3-2 shows the possible spill location, which is approximately 3.0 km east (downstream of the lake) of the Hughes River.

3.2 AMBIENT WATER QUALITY

Long term historical site-specific water quality data (i.e., for diesel, cyanide, and ammonia nitrate) are not available within the Project Area. Baseline data collection was conducted by Stantec in 2017 in the area (Figure 2-1) to evaluate the local water quality of the surface water that flows to the receiving environments of the Lynn River, Keewatin River, Cockeram Lake, Hughes River and Wetikoeekan Lake (Stantec, 2017b). The initial baseline sampling took place in March 2015 to October 2016 and additional sampling locations were added throughout the baseline monitoring period for a total of 51 locations, 22 at the MacLellan and 29 at Gordon site. Table 3-3 presents the average results from the four stations that represent the Goldsand Lake (AQM3) and Cockeram Lake (AQM9, AQM 11 and AQM 30) water quality data used for the MacLellan site and two stations (AFQ19 and AFQ20) for water quality data near the Hughes River for the Gordon site spill model. The results of this study are assumed to be representative of the background concentration of nitrate and ammonia in Keewatin River and Cockeram Lake, and Hughes River and Wetikoeekan Lake.

The water quality data showed that average pH levels in the Cockeram Lake varied from 5.45 to 7.65 with a mean pH of 6.31. The minimum pH value is lower than the CWQG-FAL and Manitoba Water Quality Standards, Objectives, and Guidelines – Freshwater Aquatic Life (MSOG-FAL) limit. Similarly, the average pH level in Wetikoeekan Lake varied from 6.6 to 7.9 with a mean of 7.01, and pH levels were within the guidance limits. pH influences chemical forms of substances and affects, for example, ammonia and metal toxicity. The pH generally follows the same seasonal pattern as water temperature; gradually increasing to a peak in late August before returning to more neutral pH by the end of September.

Cyanide is used in gold leaching from ore. Ammonia is generated during cyanide degradation. The background concentration of cyanide varied between 0.0005 mg/L and 0.002 mg/L with a mean concentration of 0.007 mg/L at Cockeram Lake. These values range from 0.001 mg/L to 0.0024 mg/L for Wetikoeekan Lake. Table 3-3 summarizes cyanide, ammonia (N) Total, and nitrite and nitrite (N) background concentrations in the study area.

Table 3-5 Summary of Background Concentration of Water Quality Parameters in the Study Area

Parameter	Units	Min	Max	Mean
Nitrate + Nitrite (as N) (Cockeram Lake)	mg/L	0.025	0.104	0.041
Nitrate + Nitrite (as N) (Wetikoeekan Lake)	mg/L	0.025	0.348	0.077
Ammonia (N) Total (Cockeram Lake)	mg/L	0.005	0.058	0.019
Ammonia (N)Total (Wetikoeekan Lake)	mg/L	0.012	0.353	0.135
Cyanide (Cockeram Lake)	mg/L	0.0005	0.002	0.0007
Cyanide (Wetikoeekan Lake)	mg/L	0.001	0.0024	0.0009

4.0 HAZARDOUS MATERIAL INFORMATION

4.1 DIESEL FUEL

The most common hydrocarbon that will be transported to the mine site is diesel fuel. Petroleum-derived diesel is composed of about 75% saturated hydrocarbons (primarily paraffin including n, iso, and cycloparaffins), and 25% aromatic hydrocarbons (including naphthalenes and alkylbenzenes) (Bacha et al. 2007). The average chemical formula for common diesel fuel is $C_{12}H_{24}$, ranging approximately from $C_{10}H_{20}$ to $C_{15}H_{28}$ (Petro Canada 2020). Diesel will be delivered to the mine site by tanker truck, and it is expected to be transported to the mine site on a year-round basis on semi-tractor / tanks with maximum capacity up to 43,900 litres.

Of 18,834 US DOT highway spill incidents reported (US DOT) from 2010 to 2020, 402 were recorded as diesel fuel spills (2.1% of all spills), of which 50 or 12.4% of all diesel spills were reported to have entered either a waterway or sewer. The average diesel spill release volume was 1394 US Ga (5277 L) which was 21% of the average total tanker capacity reported for diesel spills. The following table summarizes results of the statistical analysis on the reported diesel spills. Based on a ratio of spill volume to tanker capacity of 34% (85%ile), a reasonable spill volume was estimated to be 15,066 L. For the purpose of modelling, it will be assumed that the total spill volume of 15,066 L occurs over a period of 1 hour.

Table 4-1 Statistical Spill Volumes

Statistics	Spill Volume (Us Gal)	Spill Volume (L)	Tanker Capacity (Us Gal)	Tanker Capacity (L)	Ratio of Spill Volume to Tanker Capacity	Spill Volume Based on a Tanker Capacity of 43,900 (L)
Average	1,393.84	5,276.27	6,603.56	24,997.18	21%	9,266
75%ile	2,022.75	7,656.94	9,300.00	35,204.31	22%	9,548
85%ile	**3,260.35**	**12,341.76**	**9,500.00**	**35,961.40**	**34%**	**15,066**
95%ile	5,992.75	22,685.02	10,000.00	37,854.10	60%	26,308
Maximum	9,500.00	35,961.40	13,400.00	50,724.49	71%	31,123

Petroleum transport tankers have many integrated safety features such as low center of gravity, internal baffles, and bulkheads to limit internal liquid surge, increase the strength of the tank and account for vapour expansion/contraction due to thermal conditions. These tanker engineering safety criteria, coupled with extensive tanker driver safety training, mine access road speed limit controls and added access road safety precautions regarding the speed at which a bridge can be crossed will all further mitigate the potential for a diesel tanker spill event occurring.

Considering roadway, driver training and tanker truck design safety controls along with the ranking of the simulated spill using the last 11 years of US DOT diesel spills information, the proposed spill volume conservatively represents a credible and reasonable worse case hydrocarbon spill release.

4.2 SODIUM CYANIDE

Sodium cyanide is a poisonous compound with the formula NaCN (molar mass: 49.0072 g/mol). Cyanide (molar mass: 26.018 g/mol) has a high affinity for metals and leads to the high toxicity of this salt, which accounts for 53 percent of sodium cyanide based on the molar mass (National Research Council 1994; Sigma-Aldrich 2020; CSBP Limited 2020). Its main application, in gold mining, also exploits its high reactivity toward metals and is used as a gold leaching agent. Sodium is a relatively environmentally benign product and does not negatively affect water quality.

Just two (2) sodium cyanide releases were reported in the highway spillage category of the US DOT database. Of these, one release was of 100 lbs (45.5 kgs) from a 1000 kgs IBC container and the other was a release of 1 lb (0.45 kgs) from a 3000 lb (1364 kg) shipment. Neither case resulted in reported environmental damage or release to a waterbody or sewer. Sodium cyanide is commonly shipped in briquette form making it very stable and reducing susceptibility to spill. Therefore, the mass of sodium cyanide that will be simulated in the accidental release will be 50 kg (110 lbs). For the purpose of modelling, it will be assumed that the spill occurs over a period of 1 hour. Sodium cyanide will be transported and stored in accordance with the international Cyanide Management Code.

4.3 AMMONIUM NITRATE

Of the US DOT reported 18834 highway spills incidents, 52 were recorded as ammonium nitrate spills (0.28% of all spills), of which two (2) spills were reported to have entered either a waterway or sewer. When the US DOT database was filtered for spills where solid material was shipped in sub-containerization (i.e., bags, drums, or IBC-intermediate bulk containers) the material was packaged in sub-containers ranging from 50 - 2000 lbs (22.7 – 909 kgs). The average spilled weight was 118 lbs (54kgs) up to three (3) sub-container volumes released (i.e., 3- 50 lb bags) although on most cases a single sub-container was breached. When sub-containerized, the spilled weight ranged from 0.5% - 45% of the total shipped weight. The maximum solid form, sub-containerized ammonium nitrate release was 250 lbs (113.6 kgs). Review of the US DOT spills database indicates that when sub-containerized, ammonium nitrate release volumes are small relative to total shipping capacity and the released volumes are typically a single sub-container. Thus, based on review of the US DOT spills database simulating an ammonium nitrate release mass of 113.6 kgs will be a conservative, credible and realistic representation of a worst-case release. For the purpose of modelling, it will be assumed that the spill occurs over a period of 1 hour.

4.4 REGULATORY FRAMEWORKS

The Metal and Diamond Mining Effluent Regulation (MDMER) provides the analytical requirements and limits to reduce threats to fish and their habitat by improving the management of harmful substances in metal and diamond mining effluent. Although the MDMER is used to define effluent criteria, it was used in this study as a guide to set toxicity thresholds. The Canadian Council of Ministers of the Environment (CCME) CWQG-FAL provides science-based goals for the quality of aquatic and terrestrial ecosystems. Un-ionized ammonia concentration is reported at pH 7.5, temperature 15°C at which the unionized component of total ammonia is 0.86%, and the ionized ammonium component is 99.14%. The analytical requirements and limits for cyanide, un-ionized ammonia, and nitrate are summarized in Table 4-2.

Table 4-2 MDMER and CEQGs Allowable Concentration Limits

Parameter	MDMER (mg/l)	CCME CWQG-FAL (mg/l)
Cyanide[1]	2.000	0.005
Un-ionized ammonia	1.000	0.019[2]
Ammonia (Total)	N/A	22[2]
Nitrate	N/A	550[3]
Diesel	-	-

Notes:
[1] as free CN)
[2] Long Term (Short Term – no data)
[3] 550 mg/l for short term exposure and 13 mg/l for long term exposure.

5.0 MODELLING APPROACH AND SETUP

5.1 MODEL DESCRIPTION

5.1.1 MacLellan Site

PR 391 crosses the Keewatin River enroute to the MacLellan site. The model domain shown in Figure 2-2, included a portion of the Cockeram Lake where a release would propagate a plume due to an accidental spill of diesel, sodium cyanide and ammonium nitrate.

As explained in Sections 3.1 and 3.2, available regional and local hydrometric records of water level and flow data were analyzed to evaluate low, high, annual mean flow and water level conditions within the study area. Water levels in Cockeram Lake were used as the downstream boundary condition of the MIKE21 FM model. The flow from the Lynn river and Keewatin river were used as upstream boundary of the model and measured water level at outlet Cockeram Lake was used as downstream boundary of the hydrodynamic model.

Once the 2D hydrodynamic model was built, MIKE 21 Particle Tracking (PT), which is an add on to the MIKE21 FM, was used to model diesel, sodium cyanide and ammonium nitrate spills to the MacLellan site. The MIKE 21 PT module is used for modelling of transport and fate of dissolved, suspended and sedimented substances discharged or accidently spilled in rivers and lakes. The particle or substances may be a pollutant, conservative or non-conservative. The MIKE 21 PT module inputs included horizontal dispersion coefficient and decay rate. Horizontal dispersion coefficients were considered in the dispersion module using a scaled eddy viscosity formulation, which allowed the model to adjust the vertical and horizontal dispersion as flow condition changes. A point source was added at the location of the access road bridge over the Keewatin River, where an accidental spill was modelled to occur. Estimated flux and concentration of the accidental diesel, sodium cyanide and ammonium nitrate spills were assigned to the point source.

Figure 5-1 presents MIKE 21 computational mesh and bathymetry with 2,569 nodes, 6,917 faces and 4,344 mesh elements. Finer mesh resolution was used within the river and coarser mesh resolution was used in the lake. The available bathymetric data do not cover the Keewatin River reach; Therefore, available 20 m cell size Shuttle Radar Topography Mission (SRTM) Digital Elevation Model (DEM) was used to build the model bathymetry within the River. Cockeram Lake bathymetric data was obtained from the Manitoba Department of Agriculture and Resource Development (DARD 2021) and digitized in GIS.

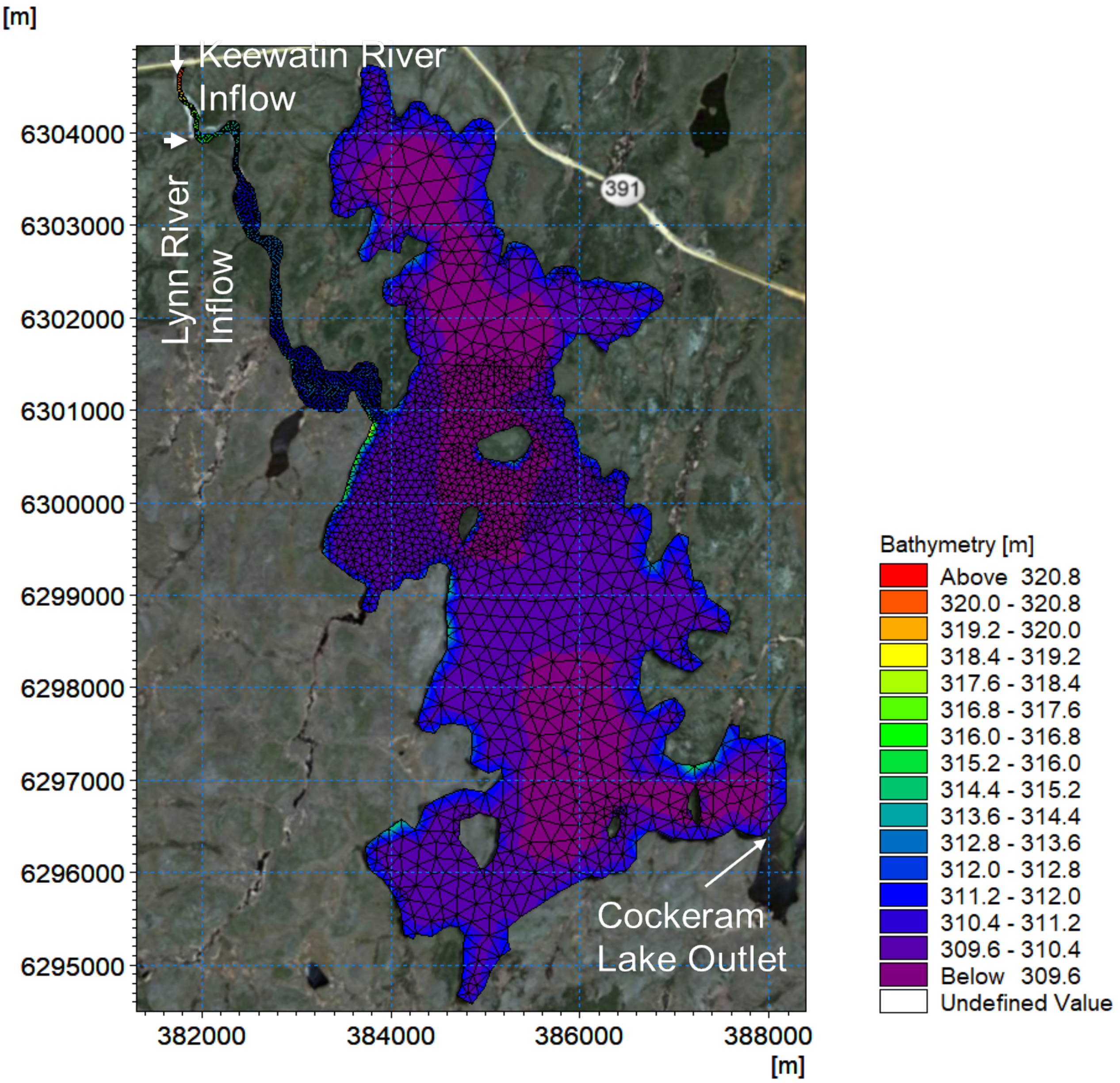


Figure 5-1 MIKE 21 FM Model Domain for MacLellan Site

5.1.2 Gordon Site

The Gordon site is located north of PR 391. An existing service road crosses the Hughes River, linking PR 391 to the Gordon site. The service road bridge crossing of the Hughes River is the site of the model simulated spill of hazardous materials. The model included a portion of the Hughes River and Wetikooekan Lake where a release would propagate a plume due to an accidental spill of diesel and ammonium nitrate. The location of the spill area is shown in Figure 2-2.

The estimated flow in the Hughes River was used to estimate the inflows to Wetikooekan Lake from the watercourse flowing into the lake. The inflow and outflow to/from the lake and lake water levels were used to assign model boundary condition in the MIKE21 model.

Once the 2D hydrodynamic model was built, MIKE 21 Particle Tracking (PT), which is an add on to the MIKE21 FM, was used to model diesel and ammonium nitrate emulsion spills to the Gordon site. The MIKE 21 PT module is used for modelling of transport and fate of dissolved, suspended and sedimented substances discharged or accidently spilled in rivers and lakes. The particle or substances may be a pollutant, conservative or non-conservative. The MIKE 21 PT module inputs included horizontal dispersion coefficient and decay rate. Horizontal dispersion coefficients were considered in the dispersion module using a scaled eddy viscosity formulation, which allowed the model to adjust the vertical and horizontal dispersion as flow condition changes. A point source was added at the location of the access road bridge over the Hughes River, where an accidental spill was modelled to occur. Estimated flux and concentration of the accidental diesel and ammonium nitrate emulsion spills were assigned to the point source.

Figure 5-2 presents MIKE 21 computational mesh and bathymetry with 10,775 nodes, and 19,215 mesh elements. Shuttle Radar Topography Mission (SRTM) Digital Elevation Model (DEM) was used to build the model bathymetry.

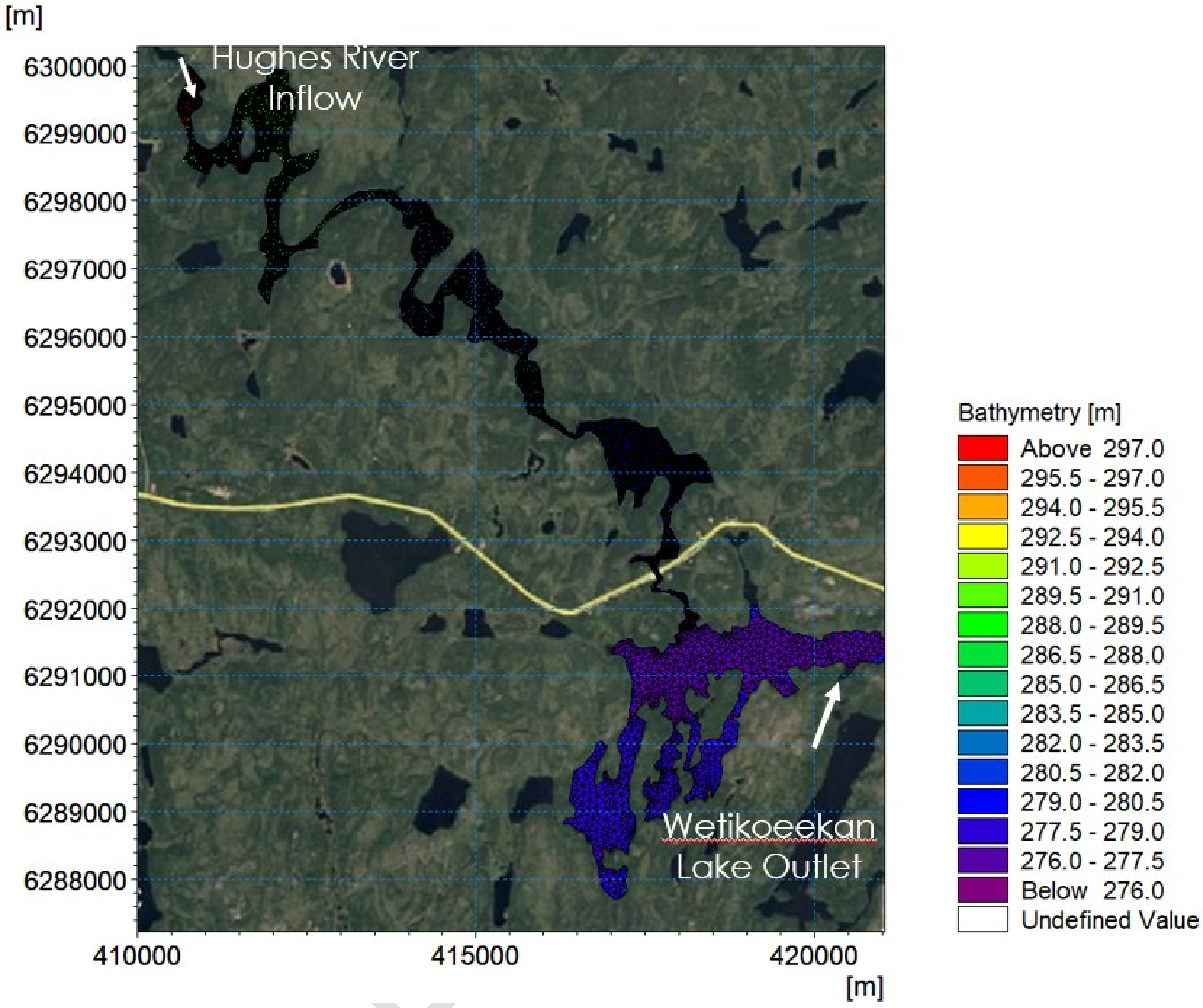


Figure 5-2 **MIKE 21 FM Model Domain for Gordon Site**

5.2 MODELLING SCENARIOS

5.2.1 MacLellan Site

The 7Q10, the MAD, and the Q20 were considered as three potential flow scenarios to estimate the inflow from each watercourse into the lake. Flow scenarios and the estimated inflow from each watercourse are summarized in Table 5-1. Each scenario was given a 30-day warm-up time to reduce the effect of the initial bias. No data were recorded during the warmup time to capture the simulation's output.

Table 5-1 Flow Scenarios to Cockeram Lake

Modelling Scenario	Flow (m)	Keewatin River Inflow (m^3/s)	Lynn River Inflow (m^3/s)	Lake Outlet Level (masl)	Simulation Period (month)
Low Flow	7Q10	0.69 -1st month 7.6 (2nd month)	0.13 - 1st month 2.7 - 2nd month	312.02	2
Average Flow	MAD	7.60	2.7	312.2	1
High Flow	Q20	40	17.8	312.65	1

5.2.2 Gordon Site

The estimated inflow for the Q20, MAD and 7Q10 flows were used in the hydrodynamic model. Flow scenarios and the estimated inflow are summarized in Table 5-2. To remove the effect of the initial bias, each scenario was modelled with a 30-day warm-up period. During this warmup period, no data were collected to record the output of the simulation.

Table 5-2 Flow Scenarios to Wetikoeekan Lake

Modelling Scenario	Flow (m)	Hughes River Inflow (m^3/s)	Lake Outlet Level (masl)	Simulation Period (month)
Low Flow	7Q10	2.72 - 1st month 17.76 - 2nd month	278.29	2
Average Flow	Annual	17.76	278.74	1
High Flow	Q20	79.22	278.92	1

The low, mean annual and high flow scenarios used in simulating spill releases associated with both the MacLellan Keewatin River and Gordon Hughes River locations were selected to represent the wide range of potential flow conditions observed seasonally. The low flow condition represents a conservative case for seasonal low flows experienced in late summer and winter, whereas the high flow condition conservatively represents seasonal high flows observed during spring freshet and large storm runoff events. The MAD represents transitional periods between seasonal high and low flows. As such, the use of selected low, mean annual and high flow conditions conservatively represents a very wide range of seasonal flows.

A model objective was to assess hazardous parameter concentrations in both downstream lakes and the lake outlet boundary. Under the mean annual and high flow conditions, the model was run for a one-month period, over which the simulated release commenced on day one and the effects of the spilled material could be assessed at the downstream lake outlet by day 30. However, under the very low 7Q10 condition hazardous parameter effects had not yet reached the downstream lake outlets and thus in the low flow scenarios a second month of simulation at MAD was added to model the effects of the spill at the downstream lake outlet.

5.3 HAZARDOUS MATERIALS SPILL ASSUMPTIONS

Diesel fuel, sodium cyanide, and ammonium nitrate (in both solid and emulsion formats) are used as a spilled hazardous material. The details of each spill material are described in below.

Diesel

Represented in Section 4.1, the ratio of spill volume to tanker capacity of 34% (85%ile), a reasonable spill volume was estimated to be 15,066 L. For the purpose of modelling, it was assumed that the total spill volume of 15,066 L occurs over a period of 1 hour. Diesel density varies between 820 kg/m^3 and 950 kg/m^3. An average density of 885 kg/m^3 was assumed for the modelling purposes.

Decay rate was defined in the model setup as a constant to estimate diesel evaporation and volatilization as a function of time. MIKE Oil Spill scientific documentation suggests 10 to 30 percent mass reduction due to evaporation and volatilization for diesel (DHI 2019). Therefore, a 20% daily decay rate was considered in the MIKE 21 PT module to estimate diesel evaporation and volatilization.

Sodium Cyanide

Sodium is a relatively environmentally benign product, and therefore only cyanide was modelled in this study. Just two (2) sodium cyanide releases were reported in the highway spillage category of the US DOT database. Of these, one release was of 100 lbs (45.5 kgs) from a 1000 kgs IBC and the other was a release of 1 lbs (0.45 kgs) from a 3000 lbs (1364 kgs) shipment. In neither case was environmental damage or release to a waterbody or sewer reported. Sodium cyanide is commonly shipped in briquette form making it very stable and reducing susceptibility to spill. Therefore, mass of sodium cyanide that will be simulated in the accidental release will be 50 kg (110 lbs). For the purpose of modelling, it will be assumed that the spill occurs over a period of 1 hour. No decay and settlement rates were considered in the model to create the worst-case conditions.

Ammonium Nitrate

Of the US DOT reported 18834 highway spills incidents, 52 were recorded as solid form ammonium nitrate spills (0.28% of all spills), of which two (2) spills were reported to have entered either a waterway or sewer. When the US DOT database was filtered for spills where solid material was shipped in sub-containerization (i.e., bags, drums or IBC-intermediate bulk containers) the material was packaged in sub-containers ranging from 50 - 2000 lbs (22.7 – 909 kgs). The average spilled weight was 118 lbs (54kgs) up to three (3) sub-container volumes released (i.e., 3- 50 lb bags) although on most cases a single sub-container was breached. When sub-containerized, the spilled weight ranged from 0.5% - 45% of the total shipped weight. The maximum solid form, sub-containerized ammonium nitrate release was 250 lbs (113.6 kgs). Review of the US DOT spills database indicates that when sub-containerized, ammonium nitrate releases volumes are small relative to total shipping capacity and the released volumes are typically a single sub-container. Thus, based on review of the US DOT spills database simulating an ammonium nitrate release mass of 113.6 kgs will be a conservative, credible and realistic representation of a worst-case release. For modelling, it was assumed that the spill occurs over a period of 1 hour.

The total amount of spilled ammonium nitrate emulsion was assumed to be 45.5 kg. To consider a worst-case scenario, it was assumed that ammonium nitrate emulsion was conservatively composed of 10% diesel and 90% ammonium nitrate. Ammonium nitrate emulsion in practical terms has the approximate consistency and viscosity of mayonnaise. The total mass of 45.5 kg was considered at the deposited location. Therefore, the total mass of diesel and ammonium nitrate were considered as 4.55 kg and 40.95 kg, respectively. The CCME CWQG-FAL concentration limits for nitrate, total ammonia, and unionized ammonia are summarized in Table 1. The concentration limit of unionized ammonia derived from total ammonia is reported at pH 7.5, temperature 15°C.

Ammonium nitrate emulsion takes considerable time to break down in water. The model used a 7-day period to commence breakdown and then 7 subsequent days to complete the dissolution and solubilization of the emulsion constituents. The solubilization time is expected to take longer than one week, however, to be conservative, it was estimated in this model to occur over a one-week period. In the subsequent weeks, the simulation results for ammonium nitrate and diesel fuel oil concentrations are discussed. No decay and settlement rates were considered for either ammonium, nitrate, or diesel.

6.0 RESULTS AND DISCUSSION - MACLELLAN SITE

6.1 INTRODUCTION

The following sections present results of the spill model simulation for MacLellan site spill location. Generated figures in MIKE 21 present the excess concentration of the hazardous materials compared to the background concentrations in the receiving waterbodies. For each spill scenario, initial concentration immediately after the spill, maximum concentration in the lake, and maximum concentration at the outlet of the lake are presented with consideration of mean background concentrations of hazardous materials in the lake presented in Section 3.2. In addition, for each spill scenario, travel time of the plume to the outlet of the lake and the time that the maximum concentration in the lake was simulated were reported.

6.2 CYANIDE AND AMMONIA CONCENTRATIONS

6.2.1 Scenario 1 – Low Flows

Figure 6-1 shows the MacLellan site spill simulation results for cyanide concentration at the beginning, and 1210 hours (approximately 50 days) after the spill. At the beginning of the simulation when the spill was modelled to occur in the Keewatin River, the maximum initial cyanide concentration was 40.1 mg/l, which was above the CWQG-FAL and MDMER limits (see Figure 6-1). The maximum total concentration of cyanide observed in the lake was 2.753 mg/l after 31 days of the spill, which is also above the CWQG-FAL and MDMER limits. Shown in Figure 6-1, the plume reached the Cockeram Lake outlet within 1210 hours (approximately 50 days) after the spill, with a maximum outlet concentration of 0.036 mg/l that was below the MDMER limit but slightly above the CWQG-FAL limit.

It is expected that the ammonium concentration follows similar behaviour to cyanide. The maximum total ammonium concentration immediately after the spill was 39.394 mg/l, of which 0.339 mg/L was in unionized ammonia form and below the MDMER limit but above and CWQG-FAL limits (see Figure 6-2). The ammonium plume reached a maximum total concentration after 31 days of spill in the lake of 1.612 mg/l of which unionized ammonia was 0.014 mg/L and below both the MDMER and CWQG-FAL. The plume reached the Cockeram Lake outlet 1210 hours (approximately 50 days) after the spill, with a maximum total ammonium concentration of 0.048 mg/L with unionized ammonia below both MDMER and CWQG-FAL limits (see Figure 6-2).

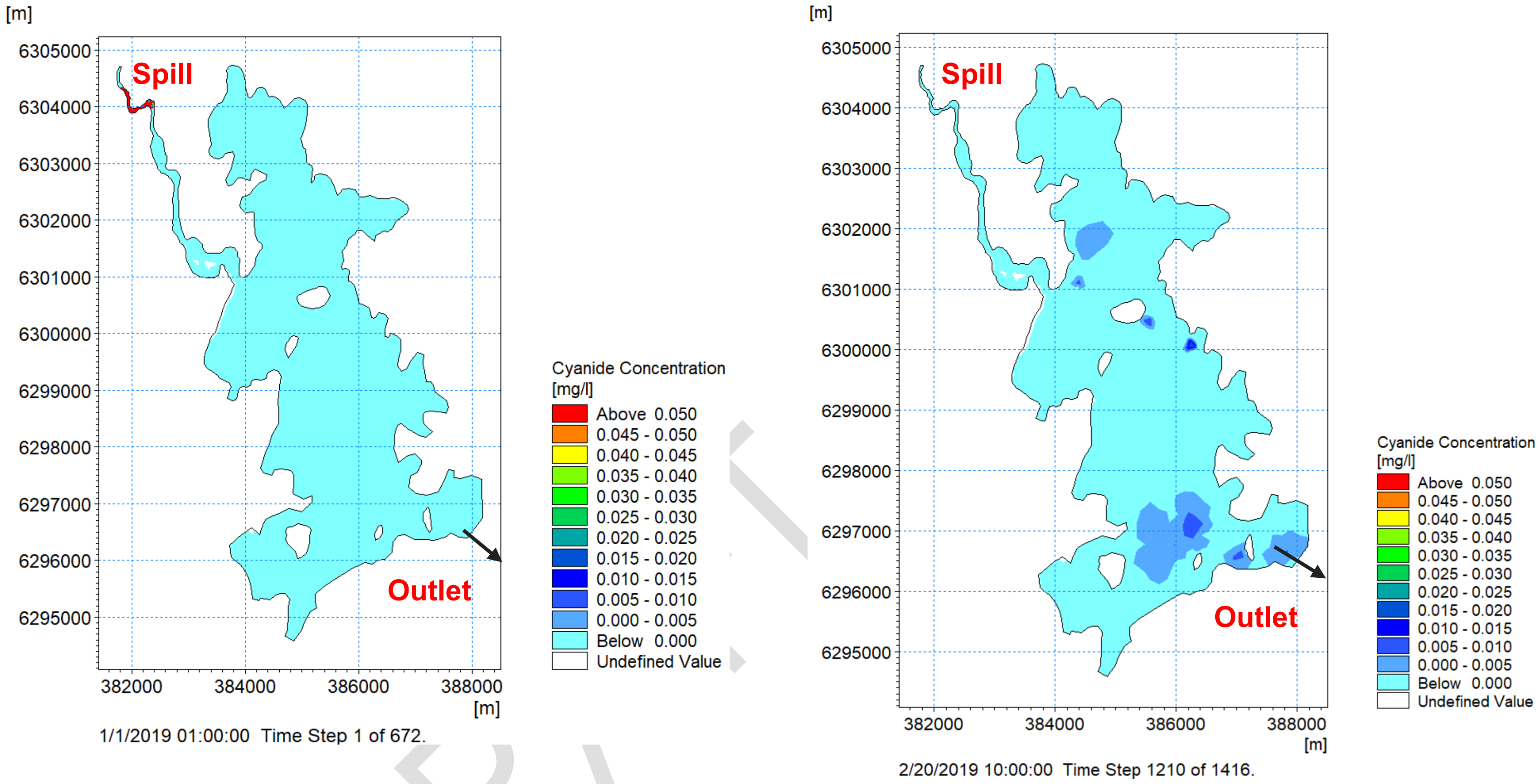


Figure 6-1 **Scenario 1 MacLellan Site - Cyanide Concentration Results: At the Beginning of the Spill (Left) and Cyanide Concentration Results 50 Days after Spill (Right)**

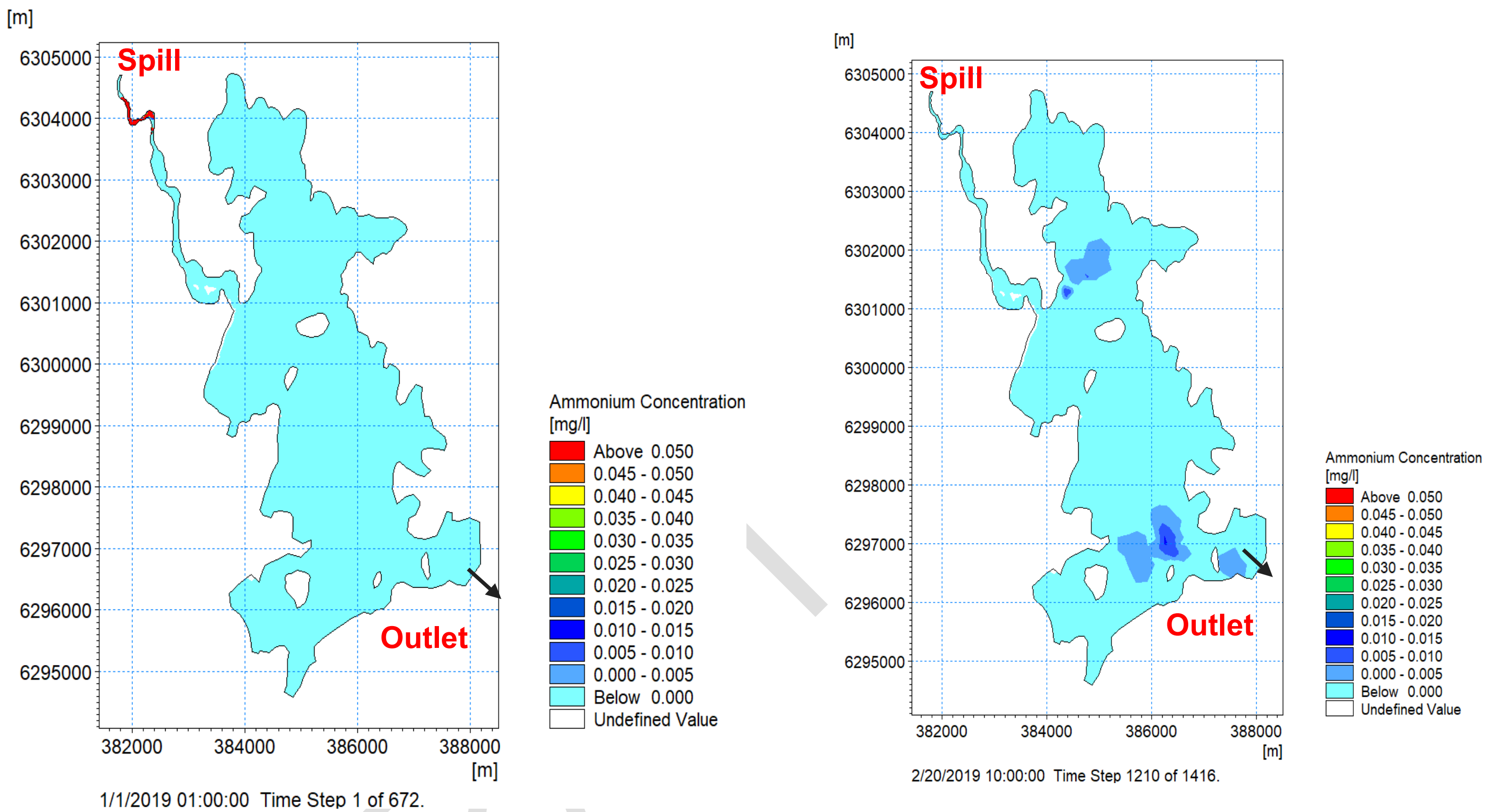


Figure 6-2 Scenario 1 MacLellan Site - Ammonium Concentration Results: At the Beginning of the Spill (Left) and 50 Days after Spill (Right)

6.2.2 Scenario 2 – Mean Annual Discharge

Figure 6-3 shows the MacLellan site spill simulation results for cyanide concentration at the beginning and 528 hours (22 days) after the spill. At the beginning of the simulation when the spill was modelled to occur in the Keewatin River, the maximum total initial cyanide concentration was 58.45 mg/l, which was above the CWQG-FAL and MDMER limits (see Figure 6-3). The maximum total concentration of cyanide within the lake was 0.702 mg/l after 12 hours of the spill which is below the MDMER limit but above the CWQG-FAL limit. As Figure 6-3 depicts, the plume reached the Cockeram Lake outlet about 528 hours (22 days) after the spill, with a maximum total outlet concentration of 0.022mg/l; below the MDMER limit but above the CWQG-FAL limit.

The maximum total ammonium concentration immediately after the spill was 34.61 mg/l, of which 0.298 mg/L was in unionized form; below the MDMER but above CWQG-FAL limits (see Figure 6-4). The maximum total concentration of ammonium within the lake was 1.77mg/l of which 0.015 mg/L in unionized form and below both the MDMER and the CWQG-FAL limits. The ammonium plume reached a maximum concentration after 12 hours of spill in the lake. The plume reached the Cockeram Lake outlet 528 hours (22 days) after the spill, with a maximum total outlet ammonium concentration of 0.067 mg/L with unionized ammonia well below the MDMER and CWQG-FAL limits (see Figure 6-4).

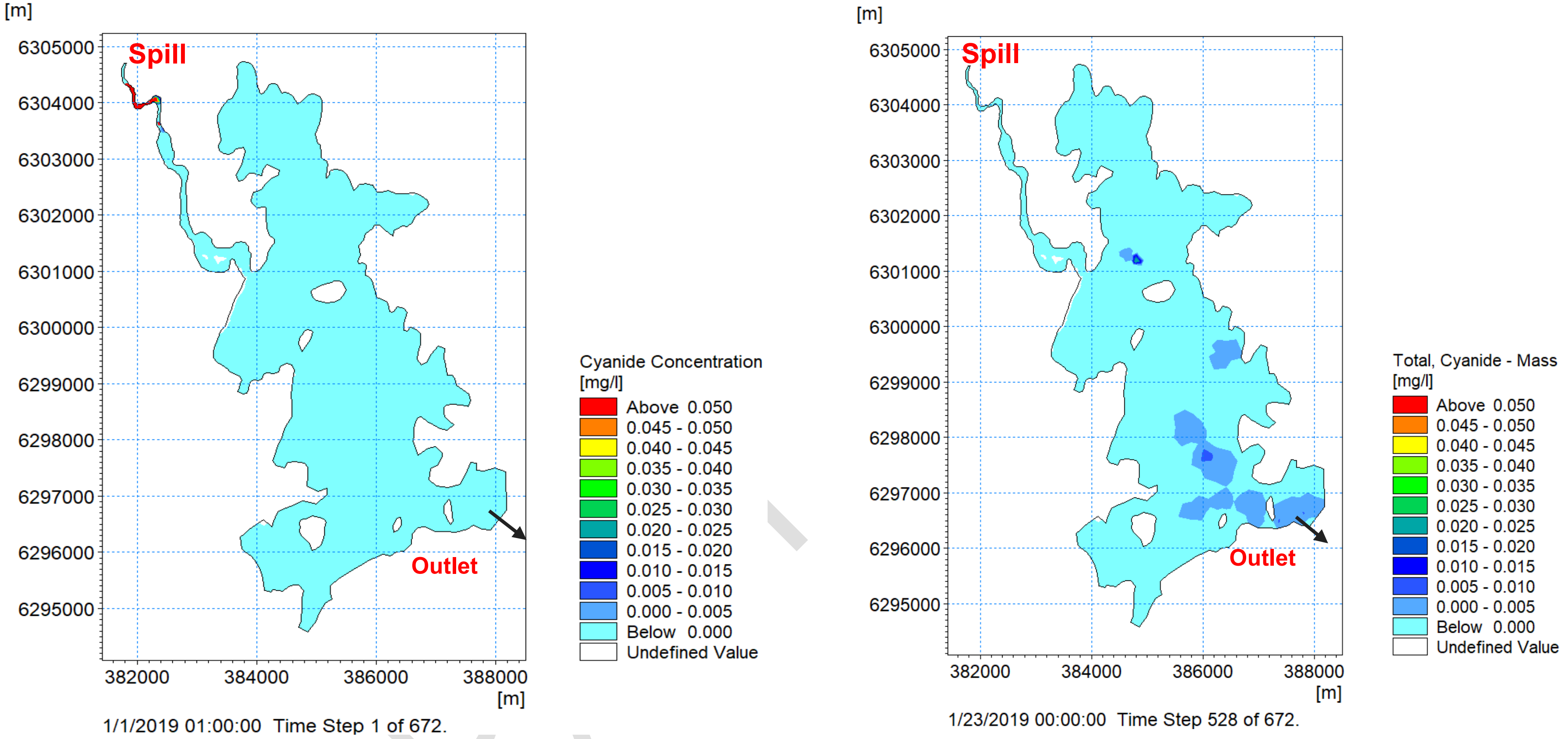


Figure 6-3 **Scenario 2 MacLellan Site - Cyanide Concentration Results: At the Beginning of the Spill (Left) and Results 22 Days after Spill (Right)**

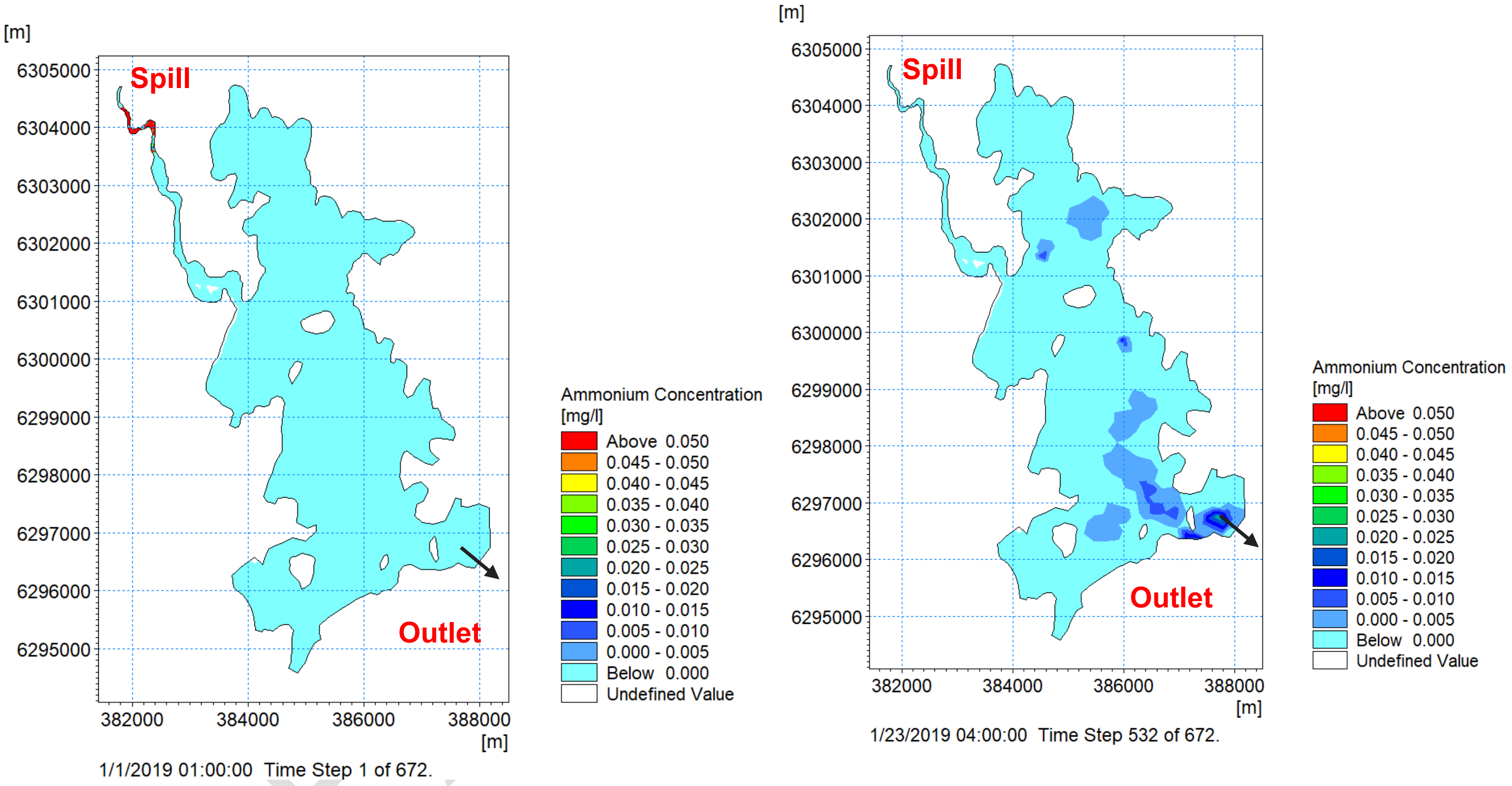


Figure 6-4 Scenario 2 MacLellan Site – Ammonium Concentration Results: At the Beginning of the Spill (Left) and Results22 Days after Spill (Right)

6.2.3 Scenario 3 – High Flows

Figure 6-5 to Figure 6-7 show the total cyanide concentration at the beginning, 3 days, and 17 days after the spill. As presented in Figure 6-5, the maximum total concentration of cyanide immediately after the spill was 3.42 mg/l, which was above the MDMER limit and the CWQG-FAL limit. In this scenario, lake water level was increased by 0.45 m and 0.63 m compared to scenario 2 and scenario 1, respectively (see Table 5-1). The increased water level and flow rate increased assimilative capacity, and therefore the mixing rate of cyanide with water, reducing the initial plume concentration compared to scenarios 1 and 2 (see Figure 6-1, Figure 6-3 and Figure 6-5). The maximum total concentration of cyanide within the lake was 0.306 mg/l after 4 days of the spill which was below the MDMER but above the CWQG-FAL limits. As Figure 6-5 depicts, the plume dispersion into the lake increased compared to scenario 2. The plume dispersion pattern was different compared to scenario 2, with a higher plume concentration at the outlet (see Figure 6-2 and Figure 6-10). As depicted in Figure 6-10 the plume reached the Outlet after 81 hours (approximately 3 days) with a maximum total concentration of 0.11 mg/l, which was below the MDMER but above the CWQG-FAL limits. After 17 days the concentration of cyanide within the lake returned to baseline conditions (see Figure 6-6).

The maximum total initial ammonium concentration was 3.373 mg/l of which 0.029 mg/L was in unionized form; below MDMER but above CWQG-FAL limits (Figure 6-7). The maximum concentration of ammonium within the lake was 0.967 mg/l of which 0.008 mg/l was in unionized form and below both the MDMER and CWQG-FAL limits. The ammonium plume reached a maximum concentration after 7 days of spill in the lake. As Figure 6-5depicts, the plume reached the outlet after 81 hours (approximately 3 days) with an ammonium concentration of 0.08mg/l and associated unionized concentration well below MDMER and CWQG-FAL limits. After 17 days the concentration of ammonium within the lake returned to baseline conditions (see Figure 6-8).

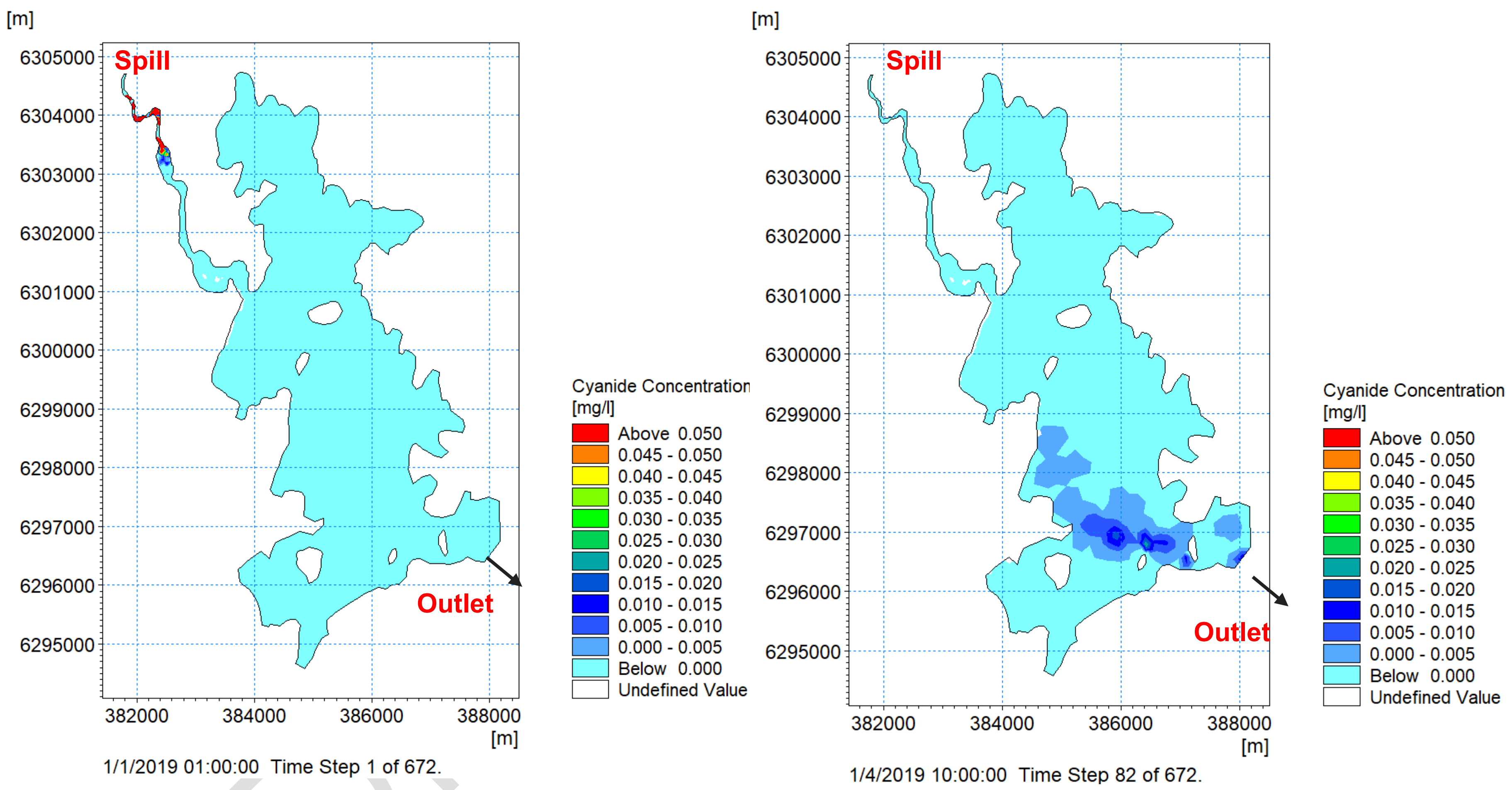


Figure 6-5 **Scenario 3 MacLellan Site - Cyanide Concentration Results: At the Beginning of the Spill (Left) and 3 Days After Spill**

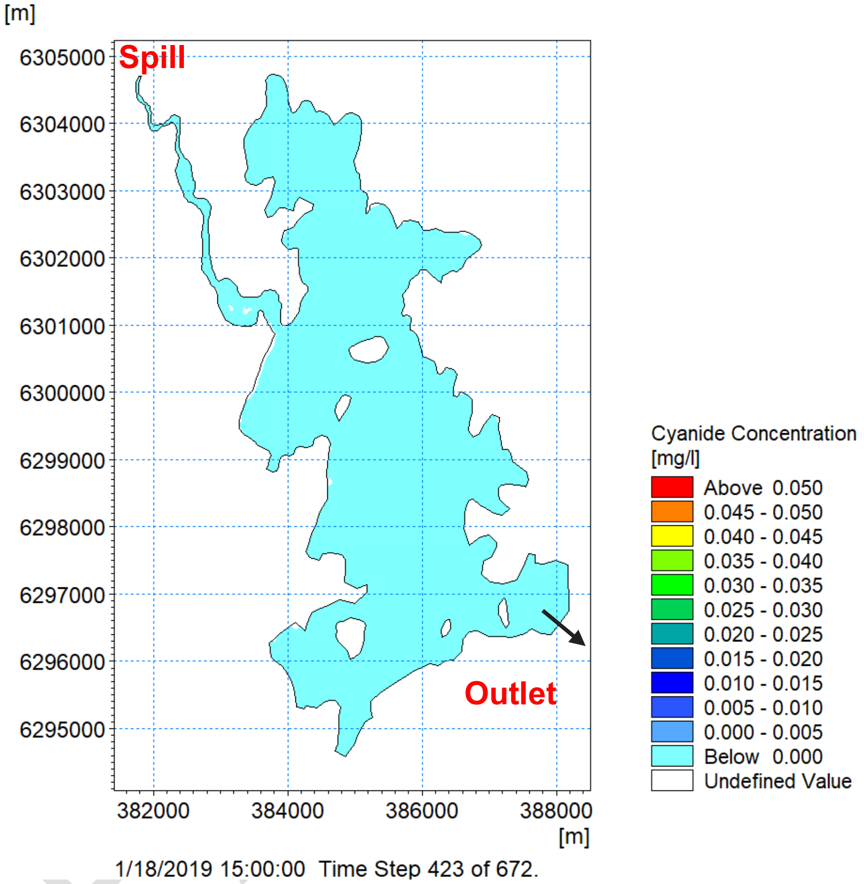


Figure 6-6 Scenario 3 MacLellan Site - Cyanide Concentration Results: At 17 Days After Spill

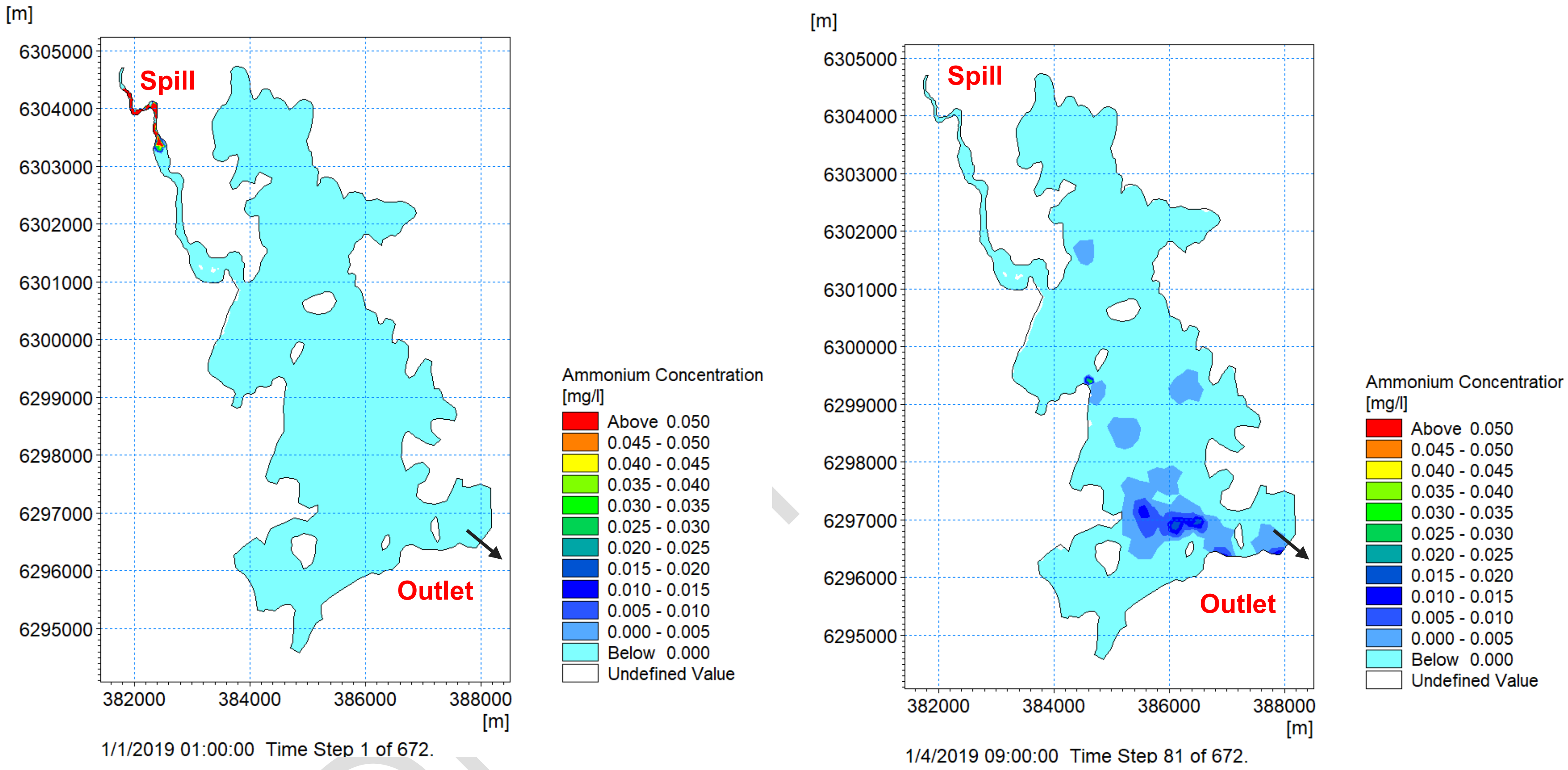


Figure 6-7 Scenario 3 MacLellan Site - Ammonium Concentration Results: At the Beginning of the Spill (Left) and 3 Days After Spill

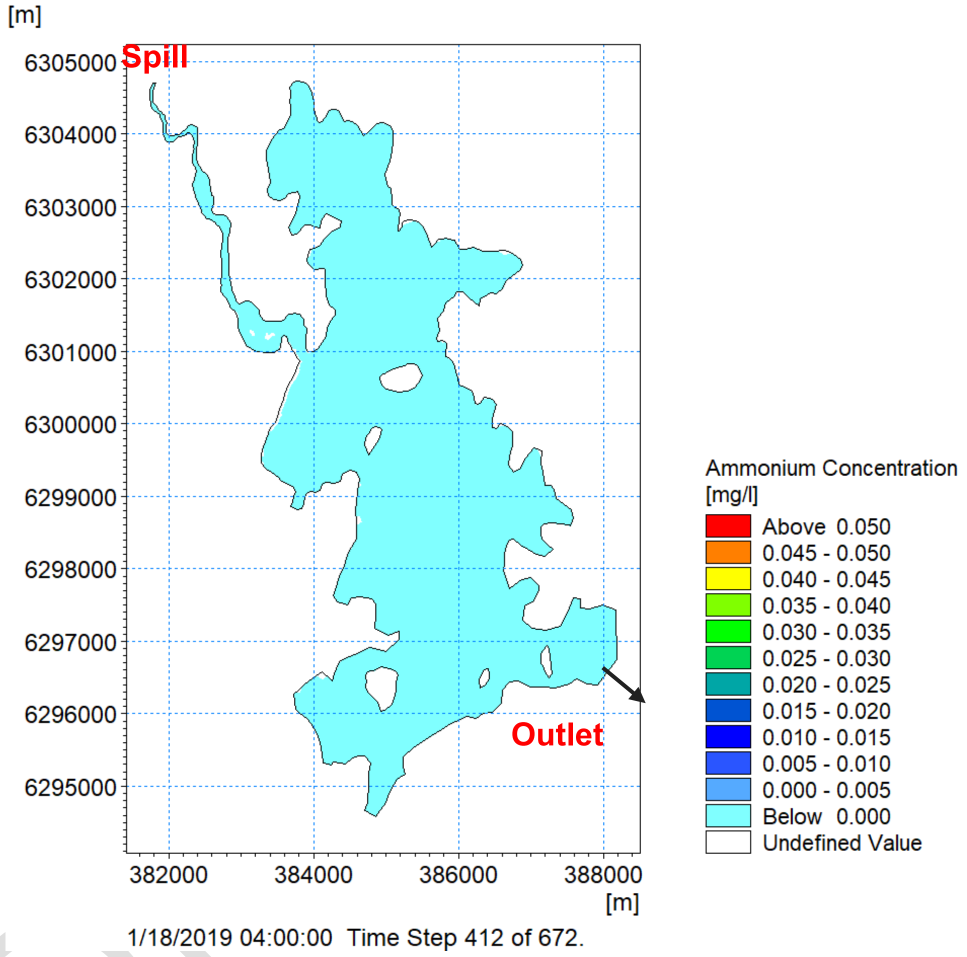


Figure 6-8 Scenario 3 MacLellan Site - Ammonium Concentration Results: At 17 Days After Spill

6.3 NITRATE CONCENTRATION

6.3.1 Scenario 1 – Low Flows

Figure 6-9 presents the nitrate concentration simulation results at the beginning, and 1210 hours (approximately 50 days) after the spill. At the beginning of the simulation, the maximum total initial nitrate concentration was 45.967 mg/l, which was below the short-term but above the long-term CWQG-FAL limit (see Figure 6-9). The maximum total concentration of nitrate within the lake was 3.772 mg/l after 31 days of the spill which was below short-term and long term CWQG-FAL limits. As Figure 6-9 depicts, the plume reached the Cockeram Lake outlet within 1210 hours (approximately 50 days) after the spill at a concentration of 0.062 mg/l which was below short-term and long term CWQG-FAL limits. The dispersion pattern of nitrate followed a similar behaviour as cyanide (see Figure 6-1 and Figure 6-3). The initial total concentration of nitrate was higher than cyanide as a larger amount of nitrate (113.6 kg) spill into the river was modelled compared to cyanide (50 kg).

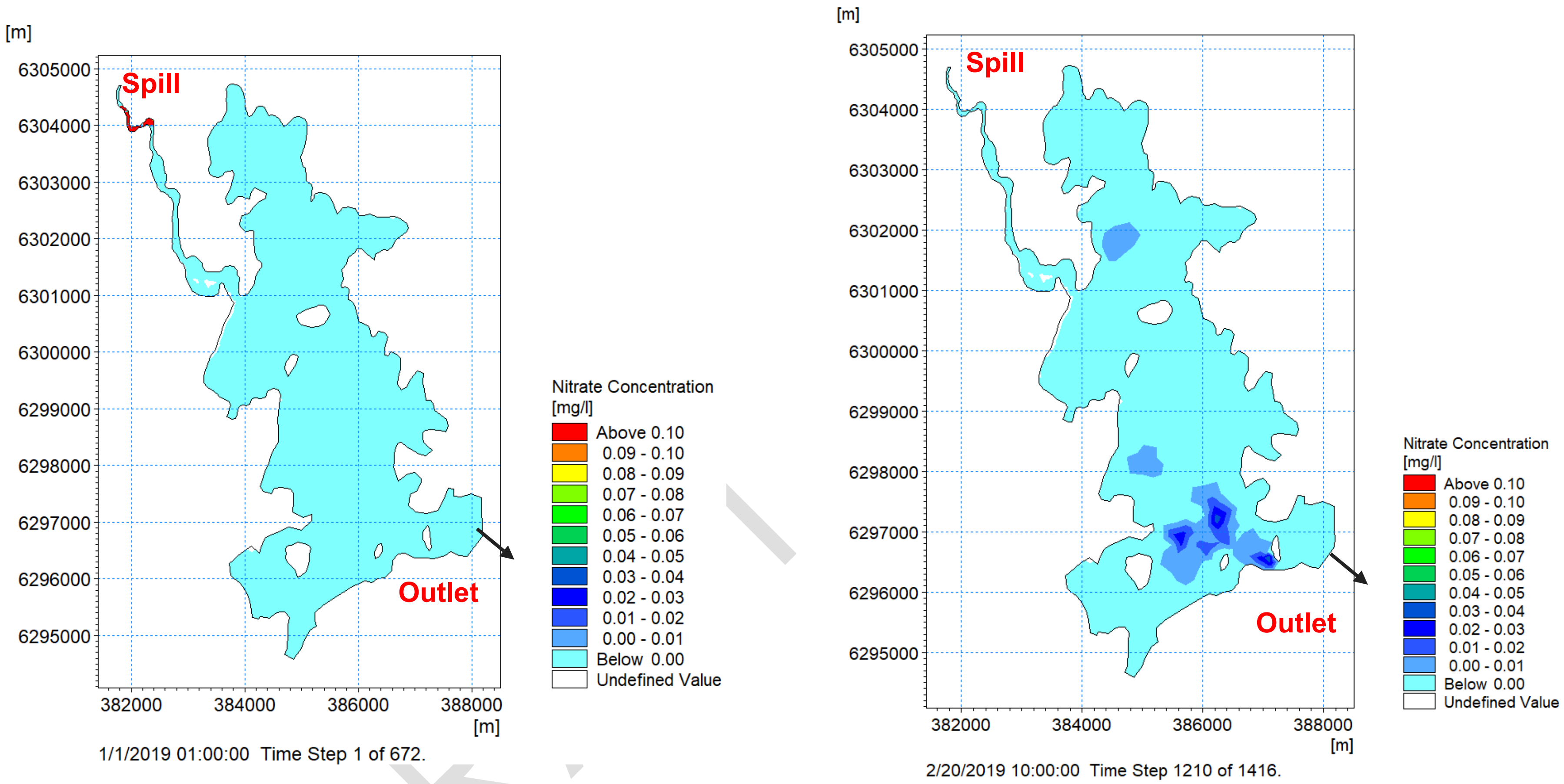


Figure 6-9 **Scenario 1 - MacLellan Site Nitrate Concentration Results: At the Beginning of the Spill (Left) and 50 Days After the Spill (Right)**

6.3.2 Scenario 2 – Mean Annual Discharge

Figure 6-10 depict the nitrate concentration simulation results at the beginning, and 22 days after the spill. At the beginning of the simulation, the maximum total initial nitrate concentration was 121.63 mg/l, which is below the short term but above the long term CWQG-FAL limits. The maximum total concentration within the lake was 7.113 mg/l after 12 hours of spill which is below short-term and long-term CWQG-FAL limits (see Figure 6-10). Shown in Figure 6-10, the plume reached the Cockeram Lake outlet within 528 hours (22 days) after the spill at a total concentration of 0.123 mg/l which is below short-term limits and long-term CWQG-FAL limits.

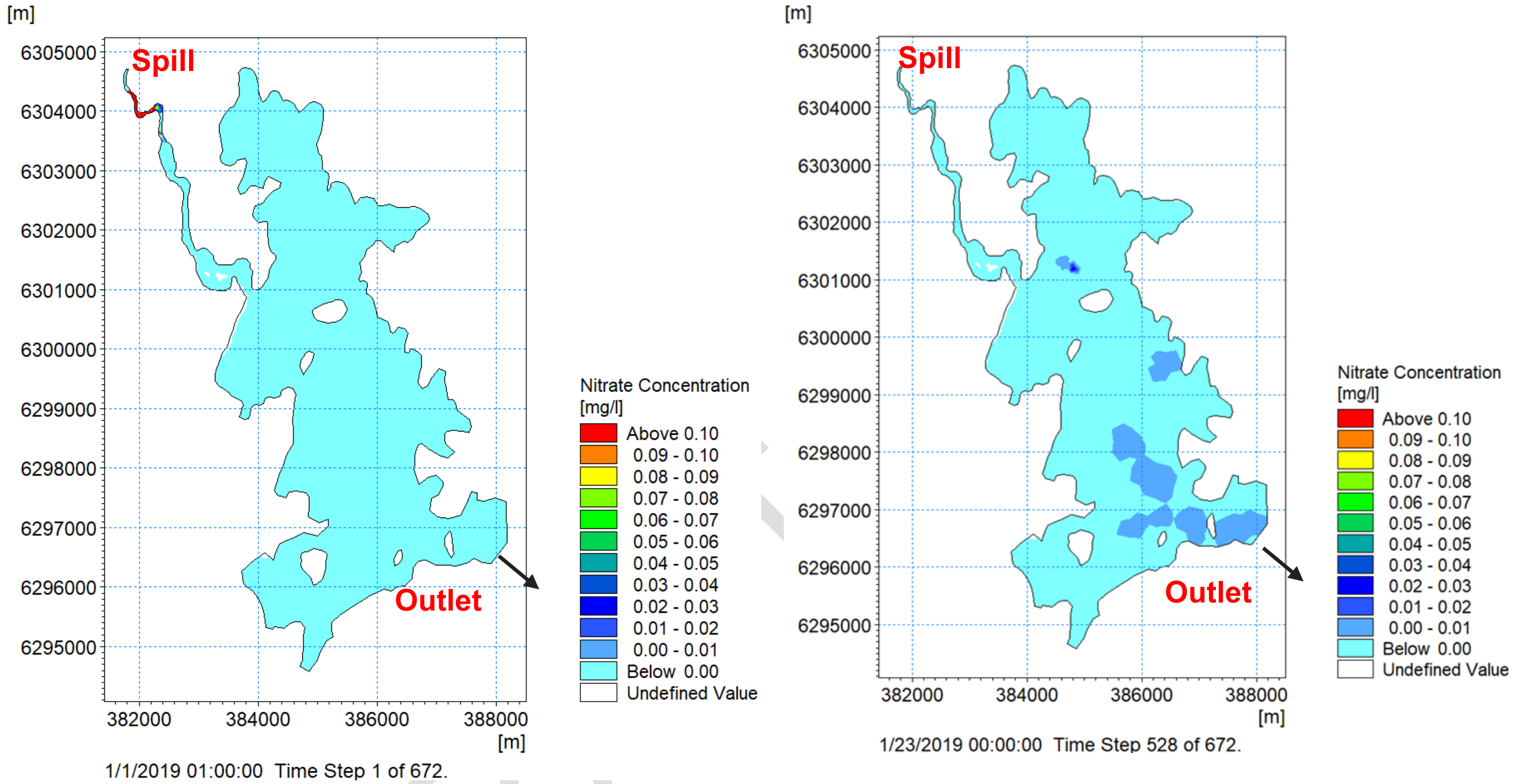
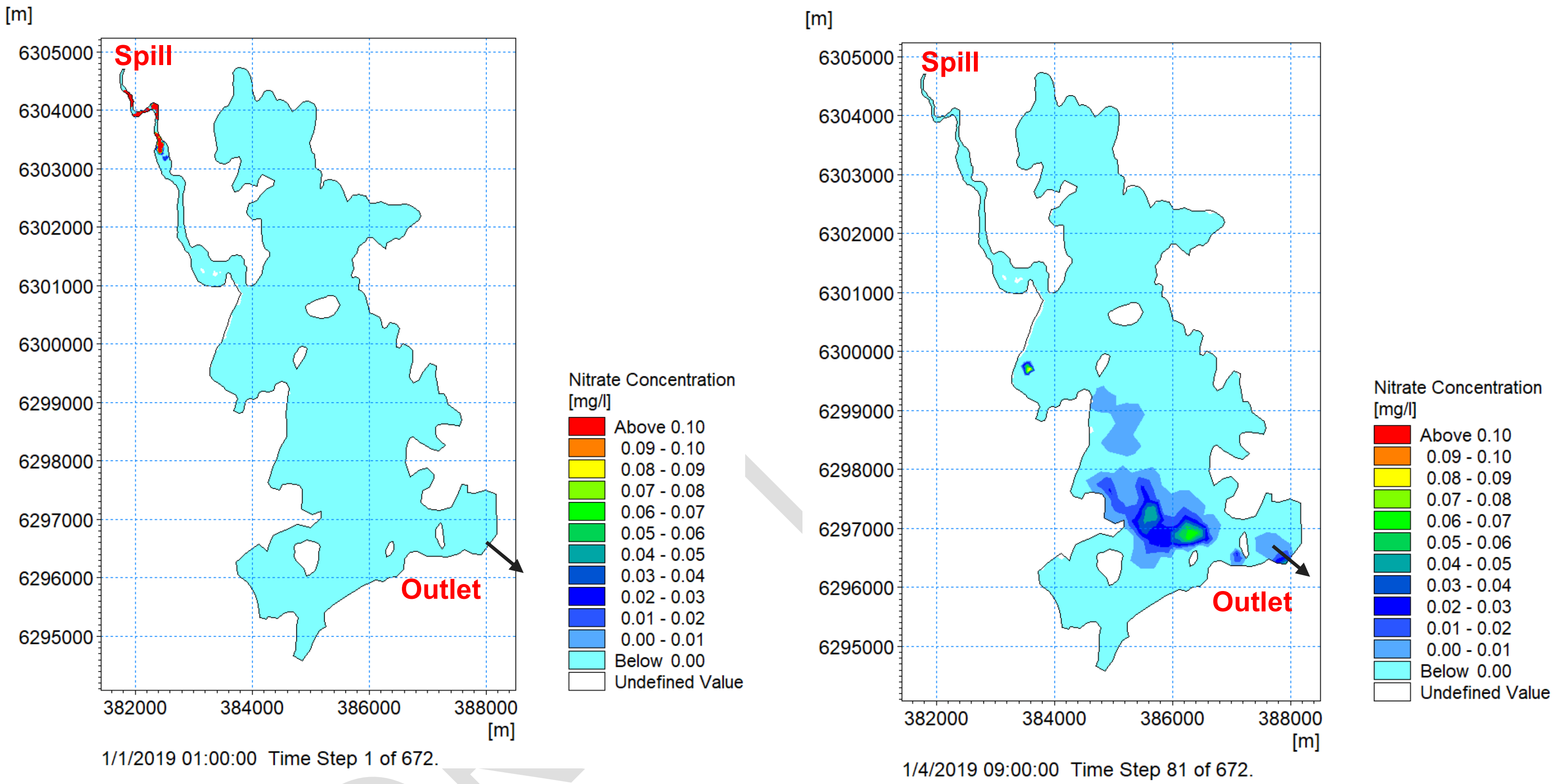


Figure 6-10 Scenario 2 - MacLellan Site Nitrate Concentration Results: At the Beginning of the Spill (Left) and 22 Days After the Spill (Right)

6.3.3 Scenario 3 – High Flows

Figure 6-11 shows the nitrate concentration at the beginning, and 81 hours (approximately 3 days) after the spill. The maximum total concentration of nitrate immediately after the spill was 13.951 mg/l and below the short-term but above the long term CWQG-FAL limit (see Figure 6-11). In this scenario, lake water level was increased by 0.45 m and 0.63 m compared to scenario 2 and scenario 1, respectively (see Table 5-1). The increased water level and flow rate increased receiving water assimilative capacity, and therefore the mixing rate of nitrate with water in this scenario, which reduced the initial plume concentration compared to scenarios 1 and 2 (see Figure 6-9, and Figure 6-10). As Figure 6-11 depicts, the plume dispersion into the lake increased compared to scenario 2. The plume dispersion pattern was different compared to scenario 2, with an increased plume concentration at the outlet (see Figure 6-10). The maximum total concentration of nitrate within the lake was 1.989 mg/l after 12 days of the spill which is below short-term and long term CWQG-FAL limits. The plume reached the outlet after 3 days, with a maximum total nitrate concentration of 0.291 mg/l which is below short-term and long term CWQG-FAL limits (see Figure 6-11). The dispersion pattern of nitrate followed the same behaviour as cyanide and ammonium (see Figure 6-5 and Figure 6-7).



1/1/2019 01:00:00 Time Step 1 of 672.

1/4/2019 09:00:00 Time Step 81 of 672.

Figure 6-11 Scenario 3 – MacLellan Nitrate Concentration Results: At the Beginning of the Spill (Left) and 3 Days After the Spill (Right)

6.4 DIESEL CONCENTRATION

6.4.1 Scenario 1 – Low Flows

Figure 6-12 shows the diesel concentration simulation results at the beginning and 1210 hours (approximately 50 days) after the spill. No MDMER and CWQG-FAL concentration limits are reported for diesel. As depicted in Figure 6-12, the maximum initial concentration of diesel was 25932.3 mg/l due primarily to the large simulated volume of release. The maximum concentration of diesel fuel in the lake was 443.674 mg/l after 14 hours of the spill. The plume reached the Cockeram Lake outlet after 1210 hours (approximately 50 days), with a maximum concentration of 0.001 mg/l (see Figure 6-12).

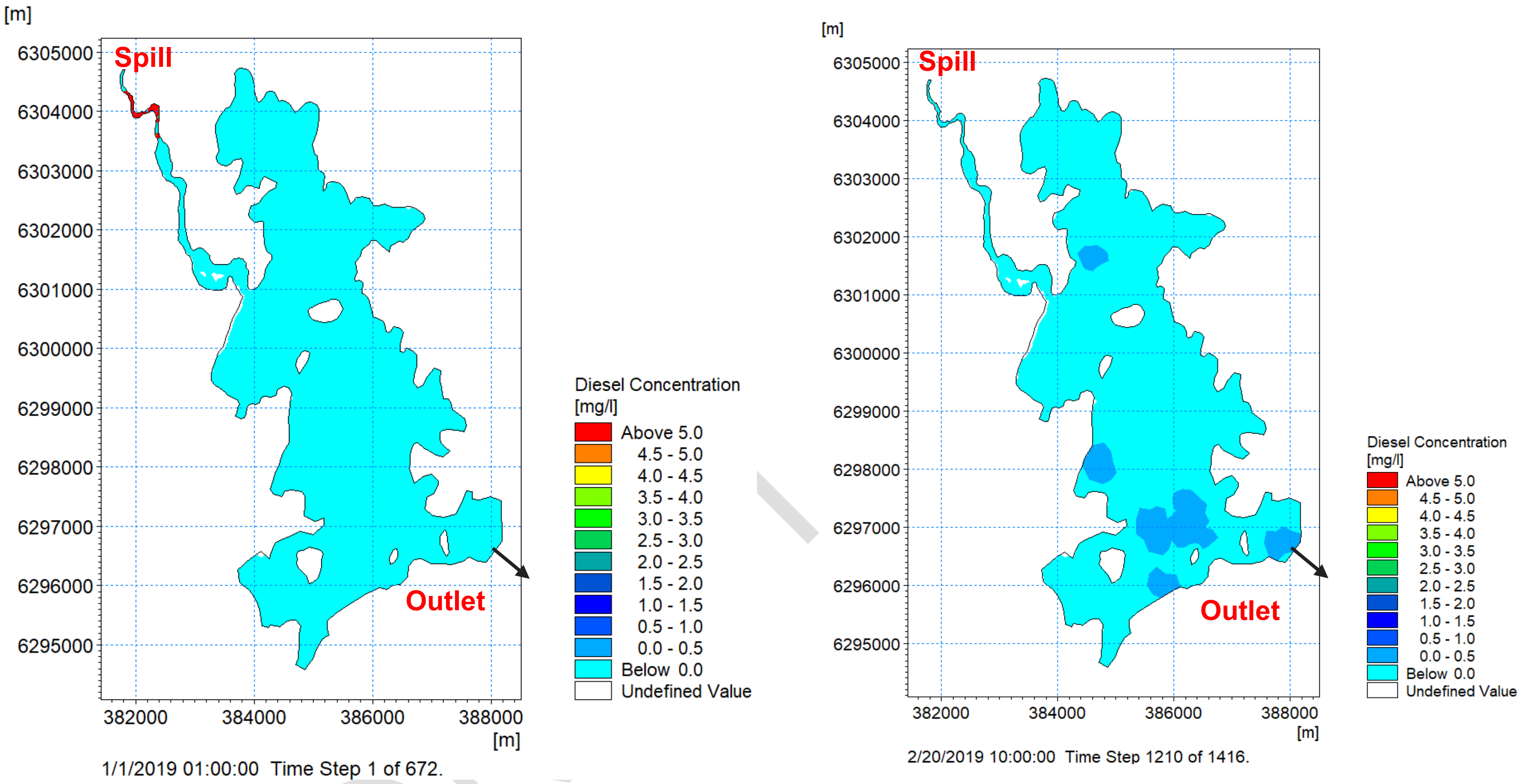
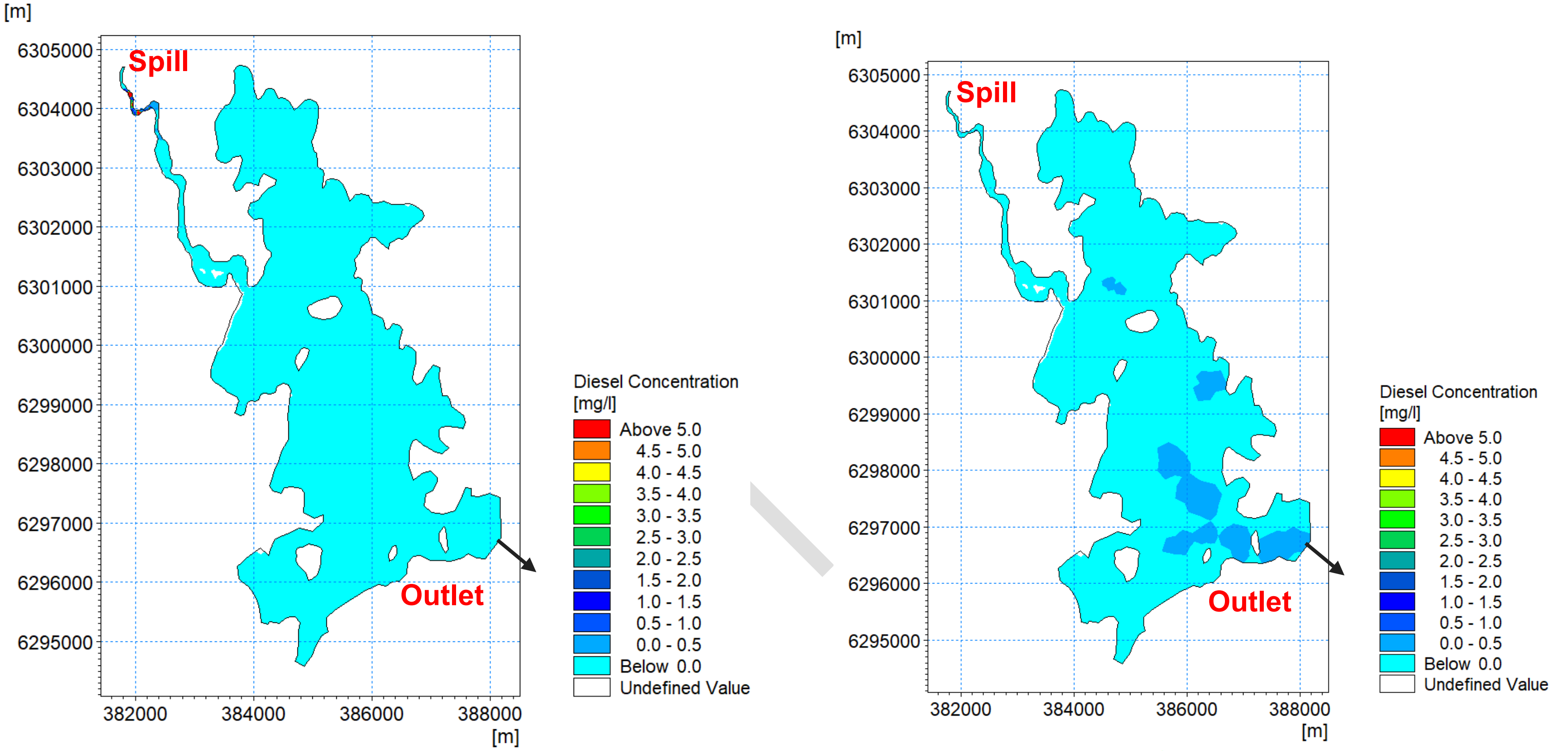


Figure 6-12 Scanario 1 - MacLellan Site Diesel Concentration Results: At the Beginning of the Spill (Left) and 50 Days After the Spill (Right)

6.4.2 Scenario 2 – Mean Annual Discharge

Figure 6-13 shows the diesel concentration simulation results at the beginning, and 528 hours (approximately 22 days) after the spill. As per Figure 6-13, the maximum initial concentration of diesel was 20,568.1 mg/l. The maximum concentration of diesel within the lake was 2109.87 mg/l after 11 hours of spill. The plume reached the Cockeram Lake outlet after 528 hours (approximately 22 days), with a maximum concentration of 0.244 mg/l (see Figure 6-13).



1/1/2019 01:00:00 Time Step 1 of 672.

1/23/2019 00:00:00 Time Step 528 of 672.

Figure 6-13 Scenario 2 - MacLellan Site Diesel Concentration Results: At the Beginning of the Spill (Left) and 22 Days After the Spill (Right)

6.4.3 Scenario 3 – High Flows

Figure 6-14 shows the diesel concentration at the beginning, and 84 hours (approximately 3 days) after the spill. The maximum initial concentration of diesel was 2584.82 mg/l (see Figure 6-14). As presented in Figure 6-12, Figure 6-13, and Figure 6-14, the increased water level and flow rate increased assimilative capacity and therefore the mixing rate of diesel with water, which reduced the initial plume concentration compared to scenarios 1 and 2. In this scenario, lake water level was increased by 0.45 m and 0.63 m compared to scenario 2 and scenario 1, respectively (see Table 5-1). The plume dispersion into the lake increased compared to scenario 2 (see Figure 6-13). The plume dispersion pattern was different compared to scenario 1, with a higher plume concentration at the Outlet (Figure 6-12). The maximum diesel concentration in the lake was 590.52 mg/l after 22 hours of spill. Shown in Figure 6-14 the maximum plume concentration reached to 11.347 mg/l at the outlet after 84 hours (approximately 3 days).

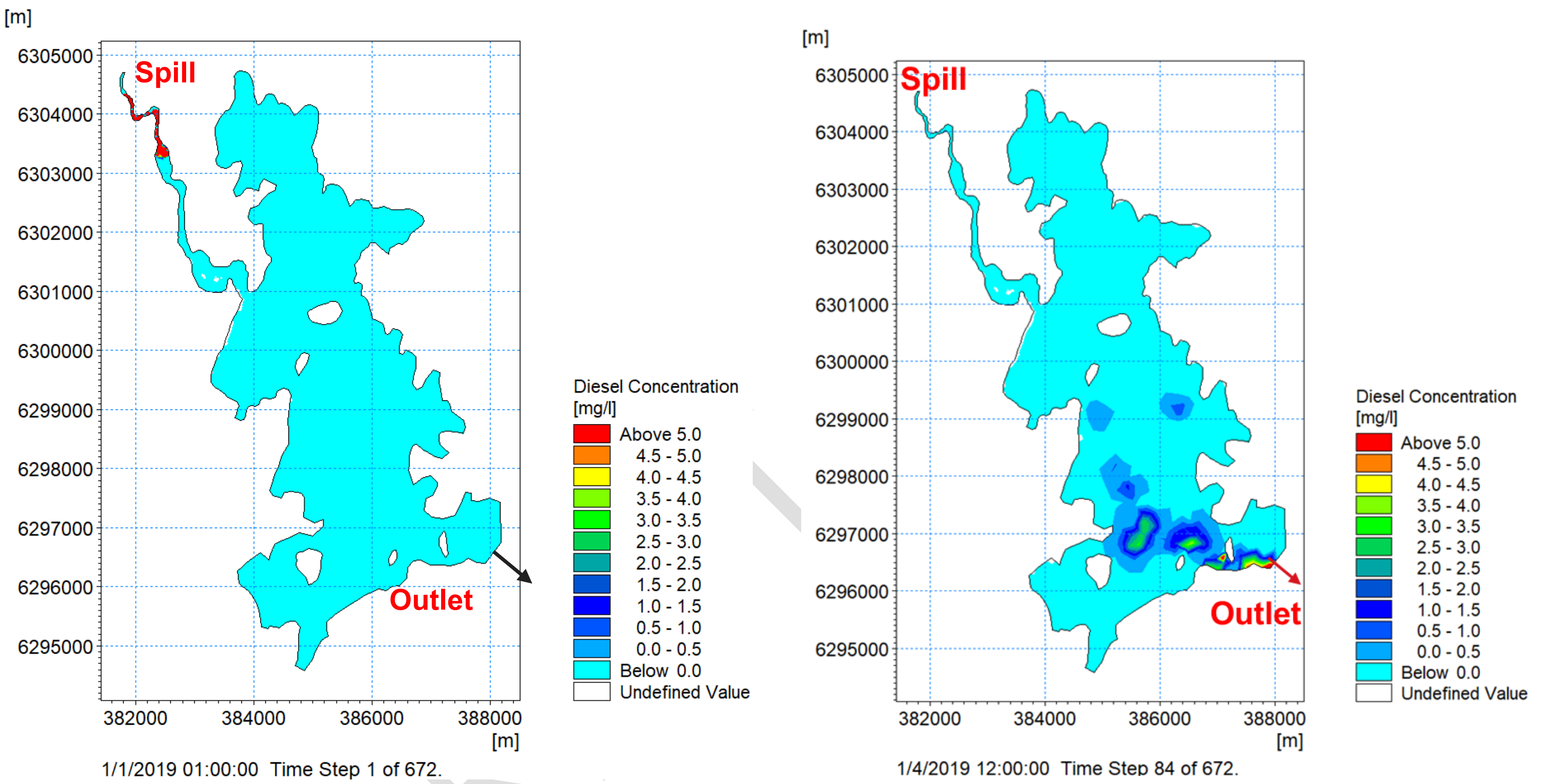


Figure 6-14 Scenario 3 - MacLellan Site Diesel Concentration Results: At the Beginning of the Spill (Left) and 3 Days After the Spill (Right)

7.0 RESULTS AND DISCUSSION - GORDON SITE

7.1 INTRODUCTION

The following sections present results of the spill model simulation for Gordon site spill location. Generated figures in MIKE 21 present the excess concentration of the hazardous materials compared to the background concentrations in the receiving waterbodies. For each spill scenario, initial concentration immediately after the spill, maximum concentration in the lake, and maximum concentration at the outlet of the lake are presented with consideration of mean background concentrations of hazardous materials in the lake presented in Section 3.2. In addition, for each spill scenario, travel time of the plume to the outlet of the lake and the time that the maximum concentration in the lake was simulated were reported.

7.2 AMMONIUM NITRATE EMULSION

7.2.1 Scenario 1 – Low Flows

The simulation results for ammonium nitrate after the breakup and dissociation process are shown in Figure 7-1 and Figure 7-2. The emulsion product was modeled to resist dissolution and solubilization for 7 days during which time the emulsion began to settle and sediment along the riverbed. In the 7Q10 scenario, ammonium nitrate reached to the Wetikoeekan Lake outlet 943 hours (approximately 39 days) after the spill. The CWQG-FAL limits for total ammonia, unionized ammonia, and nitrate are reported in Table 4 1. The maximum total ammonium nitrate concentration at the sedimentation location when breakup started was 0.828 mg/l (Figure 7-1), which included 0.638 mg/l of nitrate and 0.19 mg/l of ammonium. With consideration of background concentrations of nitrate and ammonium, the total maximum concentration of nitrate and ammonium at spill location are 0.773 mg/l and 0.267 mg/l respectively. Nitrate (molar mass: 62.004 g/mol) accounts for 77 percent of ammonium nitrate (molar mass: 80.043 g/mol) based on the molar mass (PubChem, 2020; Ammonium Nitrate, 2020). The initial total nitrate concentration was below short-term and long-term CWQG-FAL limits. Similarly, the initial ammonium concentration was below the MDMER limit and above the CWQG-FAL limit. The total maximum concentrations with consideration of background concentrations in the Lake were 0.081 mg/l of nitrate and 0.136 mg/l of ammonium and plume reached a maximum concentration in the lake after 37 days of spill. The nitrate concentration in the lake was below short-term and long-term CWQG-FAL limits and ammonium concentration was below the MDMER limit and above the CWQG-FAL limit. As per Figure 7-2, after 943 hours (approximately 39 days) ammonium and nitrate concentrations recover to baseline conditions from the spill, the plume concentration reduced below 0.079 mg/l, due to the assimilative capacity within the receiving water system. Similarly, total maximum nitrate and ammonium concentrations with consideration of background concentrations at the lake outlet were 0.078 mg/l of nitrate and 0.135 mg/l respectively. Ammonium and nitrate concentrations at the Lake outlet recovered to baseline conditions.

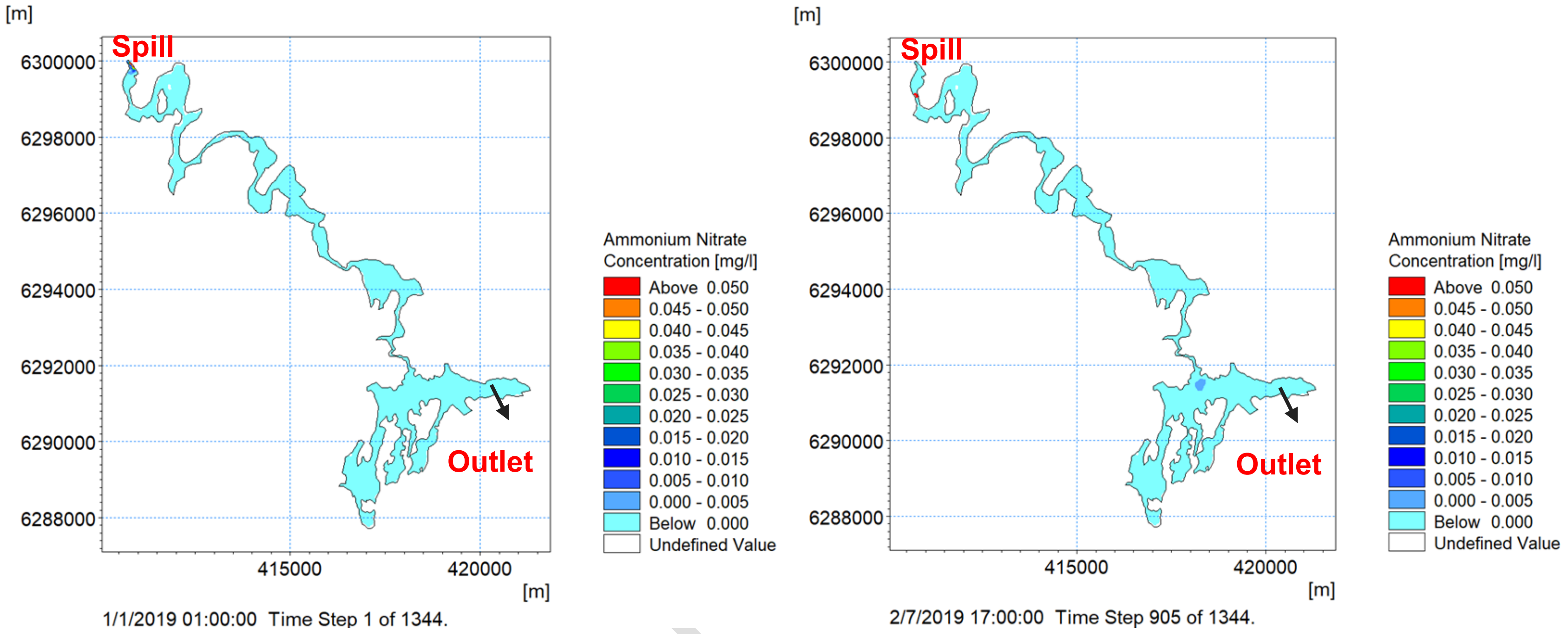
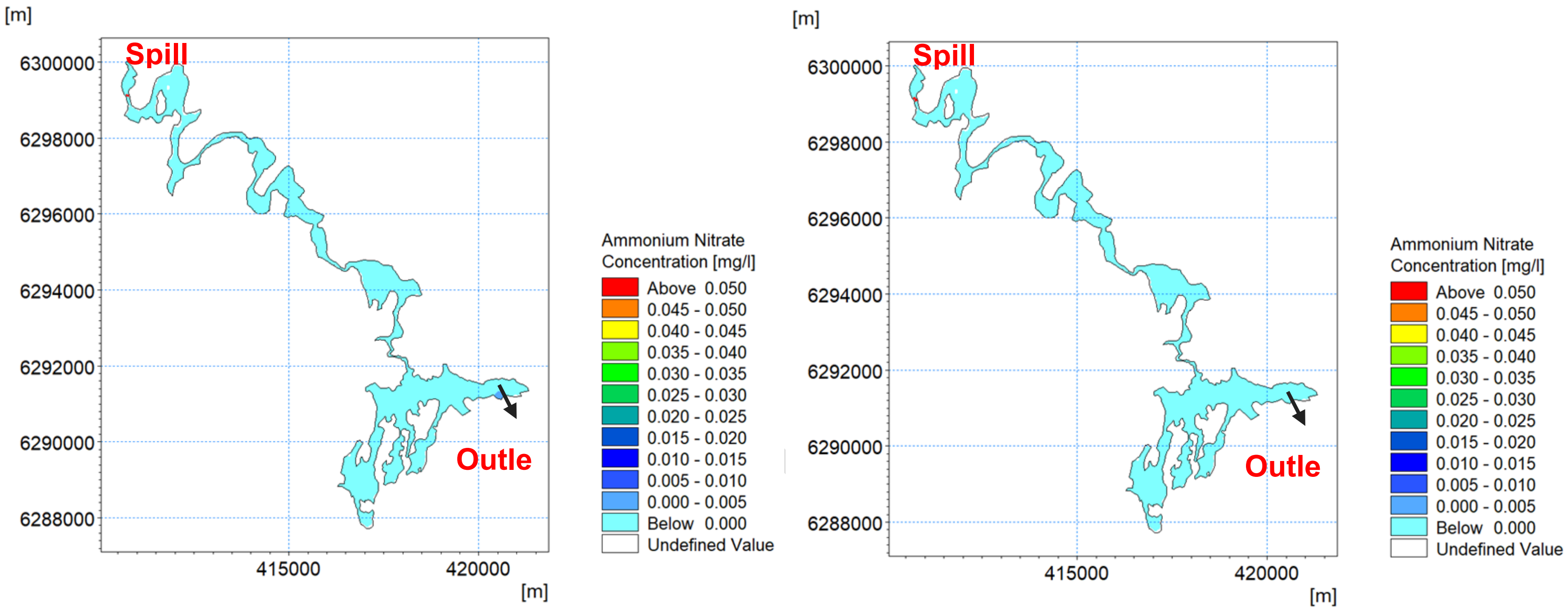


Figure 7-1 **Scenario 1 – Gordon Site Ammonium Nitrate Concentration Results: At the Beginning of the Spill (Left) and 38 Days After the Spill (Right)**



2/9/2019 07:00:00 Time Step 943 of 1344.

2/26/2019 00:00:00 Time Step 1344 of 1344.

Figure 7-2 Scenario 1 – Gordon Site Ammonium Nitrate Concentration Results: 39 Days After the Spill (Left) and 56 Days After the Spill (Right)

7.2.2 Scenario 2 – Mean Annual Discharge

Figure 7-3 to Figure 7-4 demonstrate the simulation results for ammonium nitrate after the breakdown and dissociation process. After that the emulsion product was modelled to resist dissolving and solubilization for seven days (168 hours), during which time the emulsion started to settle and sediment along the riverbed. The simulation results at different time steps are shown in Figure 7-3 to Figure 7-4. In mean annual flow condition, ammonium nitrate reached the Wetikoeekan Lake outlet after the 144 hours (6 days) after the spill. The CWQG-FAL limits for total ammonia, unionized ammonia, and nitrate are reported in Table 4-1. The mean annual discharge was considered to determine the inflows from the river, and as a result, the inflow values in scenario 2 increased by 553% compared to scenario 1. The simulation results indicate that the plume reached the lake outlet faster and moved closer to the shoreline compared to scenario 1 due to the increased flow rate (see Figure 7-2 and Figure 7-4). The maximum ammonium nitrate concentration in the River when emulsion dissolution started was 0.192 mg/l (Figure 7-3), which included 0.148 mg/l of nitrate and 0.044 mg/l of ammonium. With consideration of background concentrations of nitrate and ammonium, the total maximum concentration of nitrate and ammonium at spill location are 0.225 mg/l and 0.179 mg/l respectively. The initial total nitrate concentration was below short-term and long-term CWQG-FAL limits. Similarly, the initial ammonium concentration was below the MDMER limit and above the CWQG-FAL limit. The total maximum concentrations with consideration of background concentrations in the Lake were 0.082 mg/l of nitrate and 0.136 mg/l of ammonium and plume reached a maximum concentration in the lake after 5 days of spill. The nitrate concentration in the lake was below short-term and long-term CWQG-FAL limits and ammonium concentration was below the MDMER limit and above the CWQG-FAL limit. Similarly, total maximum nitrate and ammonium concentrations with consideration of background concentrations at the lake outlet were 0.077 mg/l of nitrate and 0.135 mg/l respectively. Ammonium and nitrate concentrations at the Lake outlet recovered to baseline conditions.

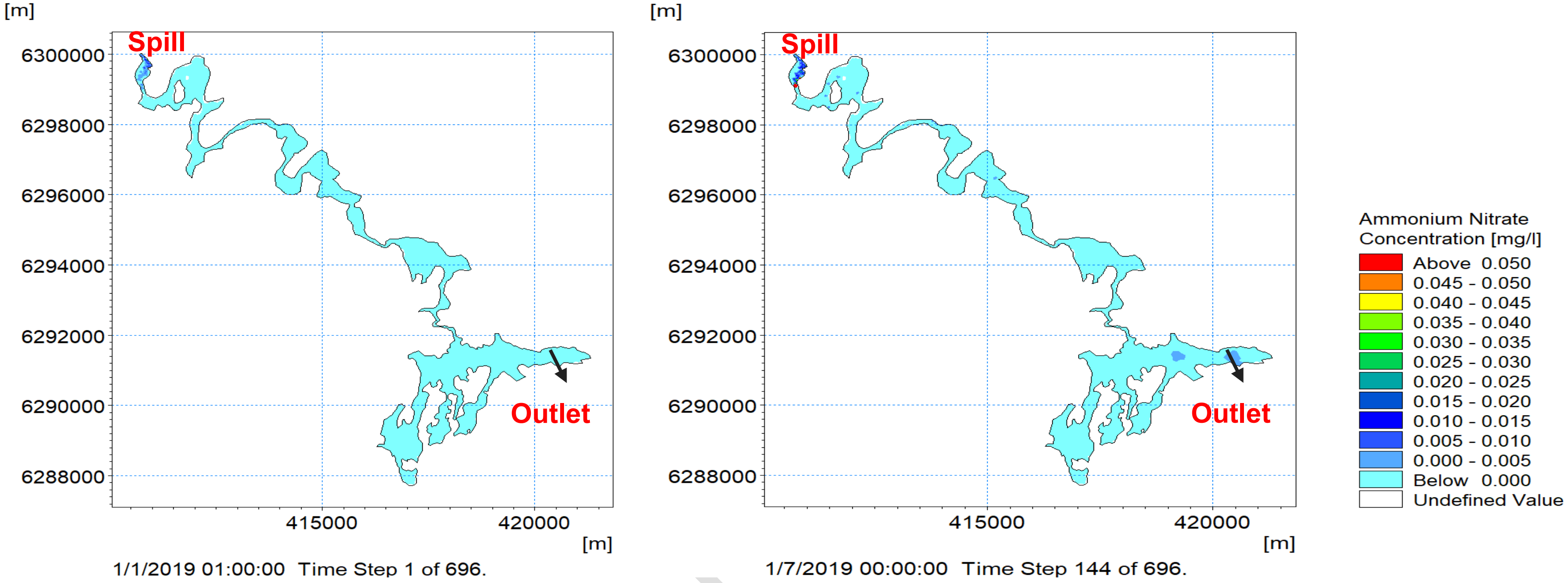


Figure 7-3 **Scenario 2 – Gordon Site Ammonium Nitrate Concentration Results: At the Beginning of the Spill (Left), 6 Days After the Spill (Right)**

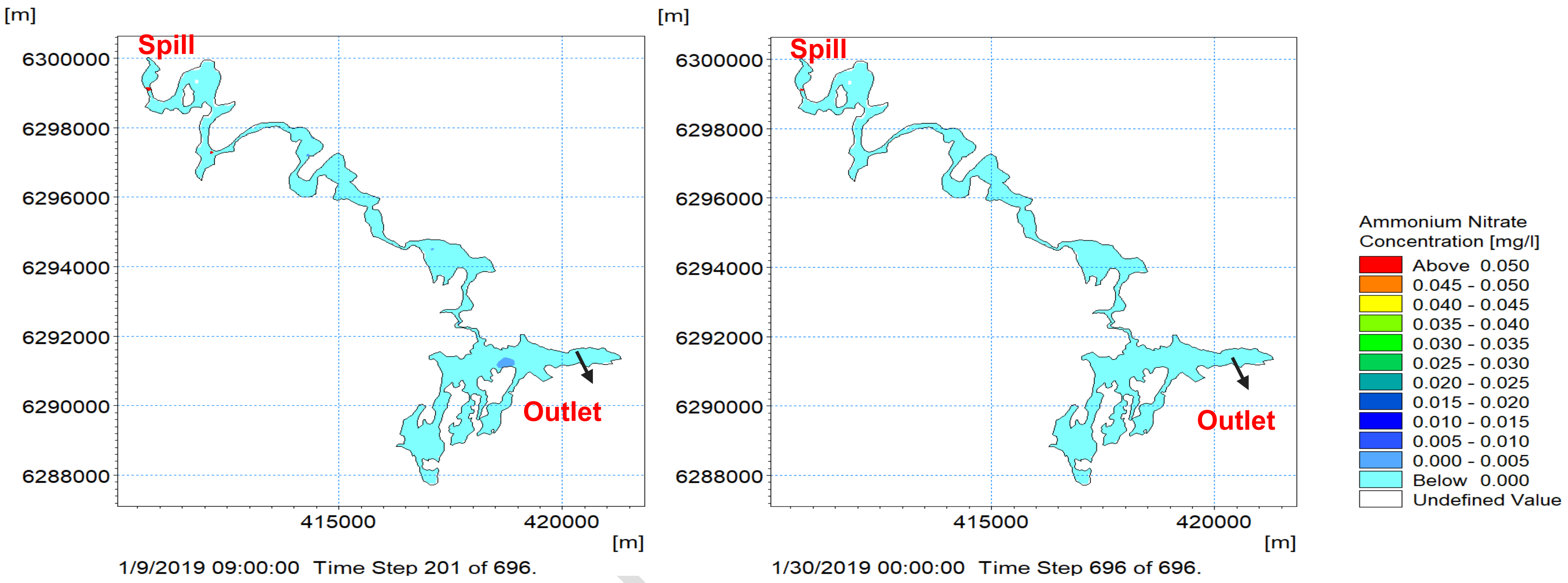


Figure 7-4 **Scenario 2 – Gordon Site Ammonium Nitrate Concentration Results: 8 Days After the Spill (Left) and 29 Days After the Spill (Right)**

7.2.3 Scenario 3 – High Flows

The simulation results for ammonium nitrate after the breakdown and dissociation process are shown in Figure 7-3 to Figure 7-4. The emulsion product was modelled to resist dissolving and solubilization for seven days (168 hours), during which time the emulsion started to settle and sediment along the riverbed. In high flow (Q20) condition, ammonium nitrate reached to the Wetikoeekan Lake outlet 25 hours (approximately 1 day) after the spill. The simulation results at different time steps are shown in Figure 7-5 to Figure 7-6. In this scenario, the water level was increased by 0.18 m and 0.63 m compared to scenario 2 and scenario 1, respectively (see Table 5-2). The 1:20 year high flow resulted in a 346% and a 2813% flow increase compared to scenario 2 and scenario 1, respectively (see Table 5-2). The maximum ammonium nitrate concentration at the spill location when dissolution started was 0.113 mg/l, which included 0.087 mg/l of nitrate and 0.026 mg/l of ammonia. With consideration of background concentrations of nitrate and ammonia, the total maximum concentration of nitrate and ammonia at spill location are 0.164 mg/l and 0.161 mg/l respectively. The initial total nitrate concentration was below short-term and long-term CWQG-FAL limits. Similarly, the initial ammonium concentration was below the MDMER limit and above the CWQG-FAL limit. The total maximum concentrations with consideration of background concentrations at the Lake were 0.085 mg/l of nitrate and 0.138 mg/l of ammonia and plume reached a maximum concentration in the lake after 9 days of spill. The nitrate concentration in the lake was below short-term and long-term CWQG-FAL limits and ammonium concentration was below the MDMER limit and above the CWQG-FAL limit. Similarly, total maximum nitrate and ammonium concentrations with consideration of background concentrations at the lake outlet were 0.078 mg/l of nitrate and 0.135 mg/l of ammonia. Ammonium and nitrate concentrations at the Lake outlet recovered to baseline conditions.

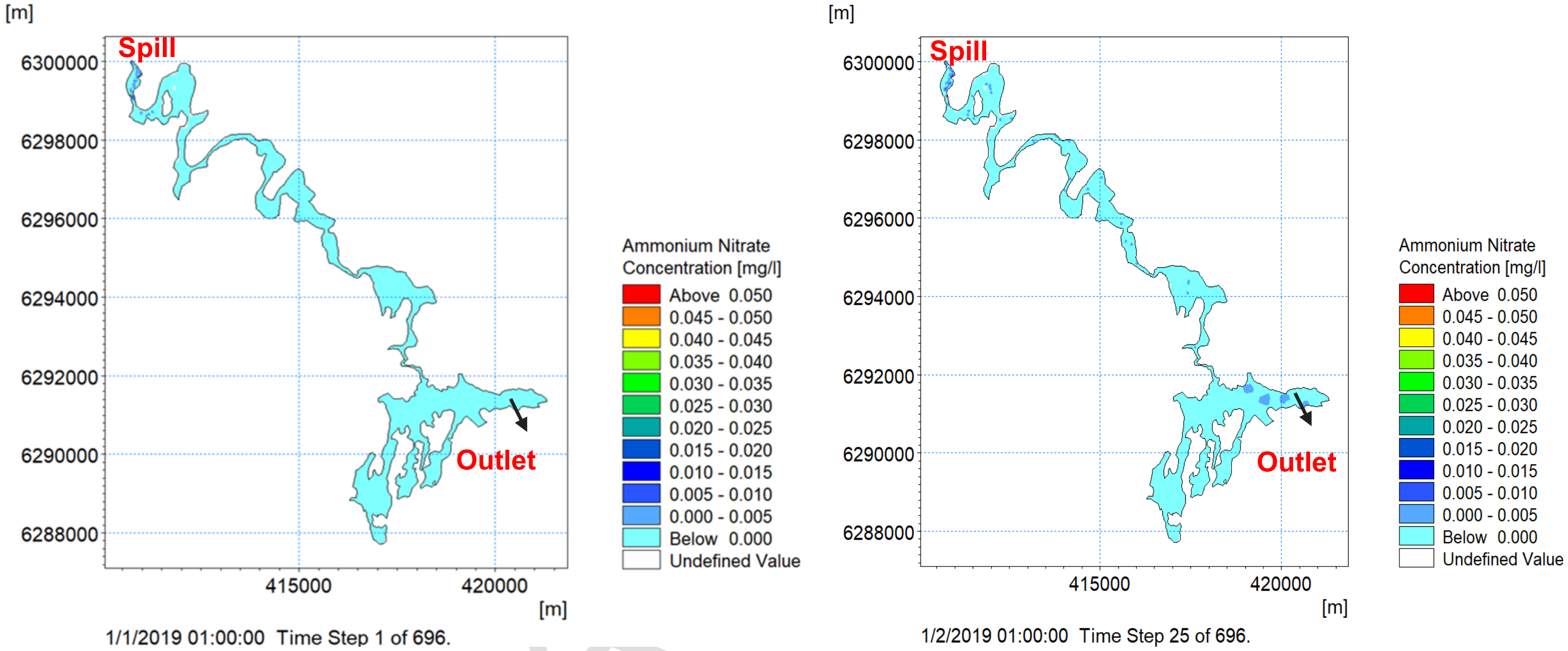


Figure 7-5 Scenario 3 – Gordon Site Ammonium Nitrate Concentration Results: At the Beginning of the Spill (Left) and 25 Hours After the Spill (Right)

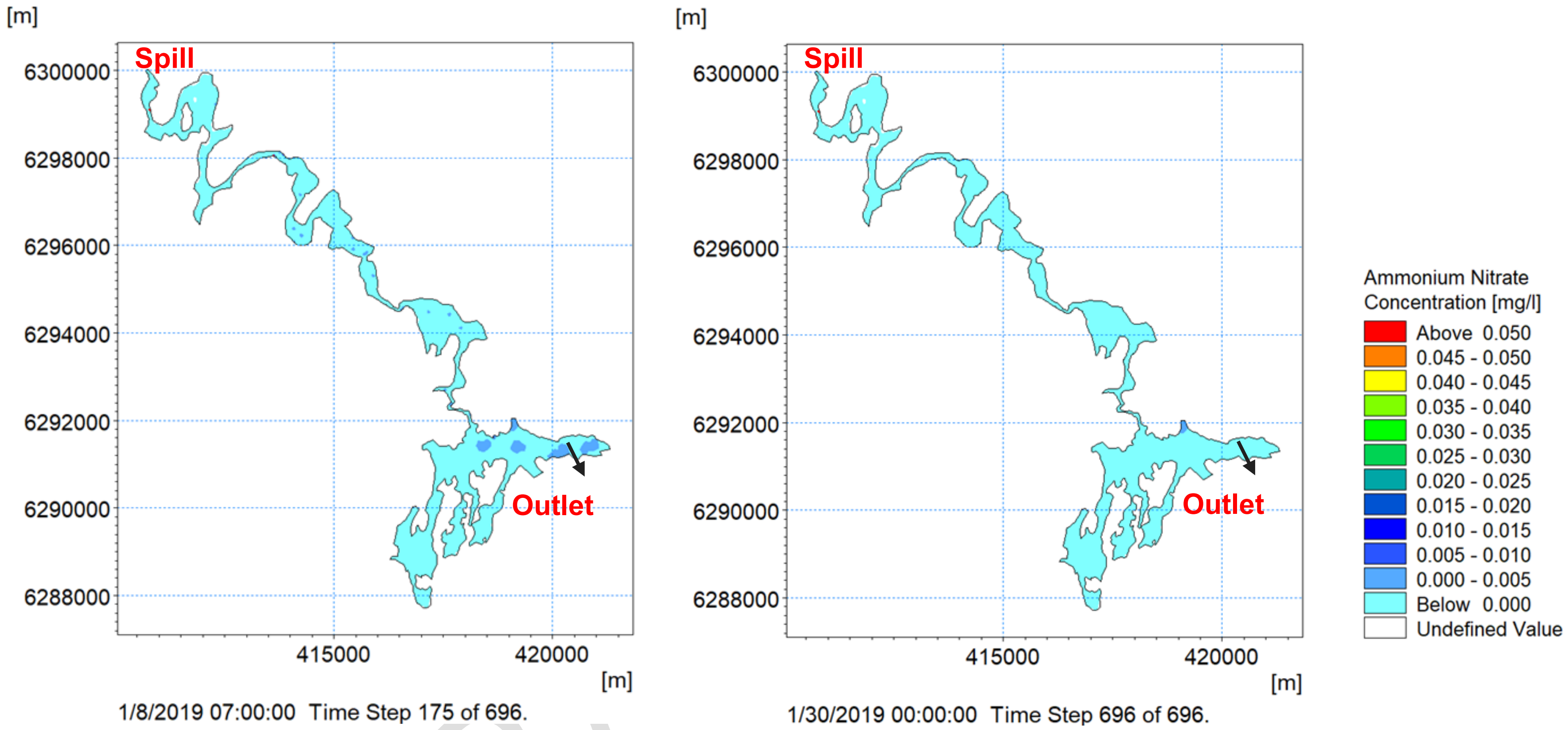


Figure 7-6 **Scenario 3 – Gordon Site Ammonium Nitrate Concentration Results: 7 Days After the Spill (Left) and 29 Days After the Spill (Right)**

7.3 DIESEL CONCENTRATION

7.3.1 Scenario 1 – Low Flows

Figure 7-7 shows the diesel concentration simulation results at the beginning and 886 hours (approximately 37 days) after the spill. No MDMER and CWQG-FAL concentration limits are reported for diesel. As depicted in Figure 7-7, the maximum initial concentration of diesel was 13810.0 mg/l due primarily to the large simulated volume of release. The maximum concentration of diesel fuel in the lake was 0.401 mg/l after 35 days of the spill. The plume reached the Wetikoeekan Lake outlet after 886 hours (approximately 37 days), with a maximum concentration of 0.05 mg/l (see Figure 7-7).

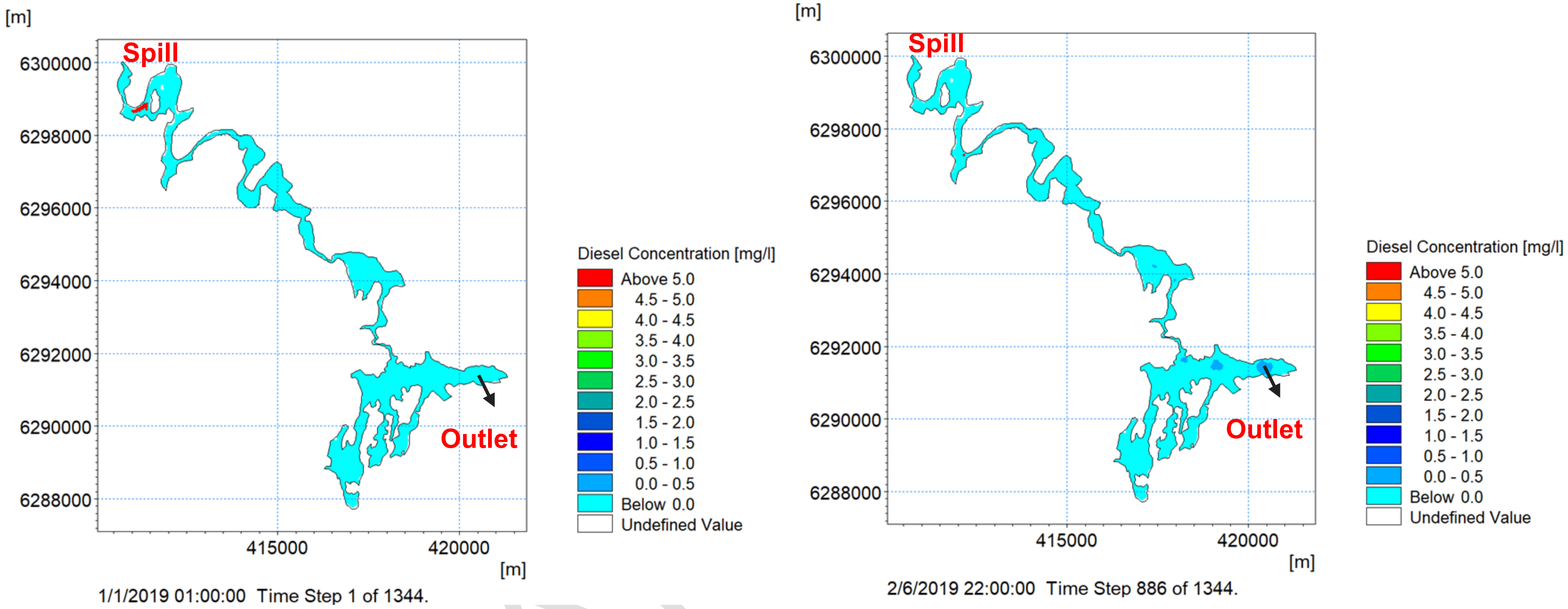


Figure 7-7 **Scenario 1 – Gordon Site Diesel Concentration Results: At the Beginning of the Spill (Left) and 37 Days After the Spill (Right)**

7.3.2 Scenario 2 – Mean Annual Discharge

Figure 7-8 shows the diesel concentration simulation results at the beginning, and 94 hours (approximately 4 days) after the spill. As per Figure 7-8, the maximum initial concentration of diesel was 5790.9 mg/l. The maximum concentration of diesel within the lake was 12.15 mg/l after 3 days of the spill. The plume reached the Wetikoeekan Lake outlet after 94 hours (approximately 4 days), with a maximum concentration of 0.94 mg/l (see Figure 7-8).

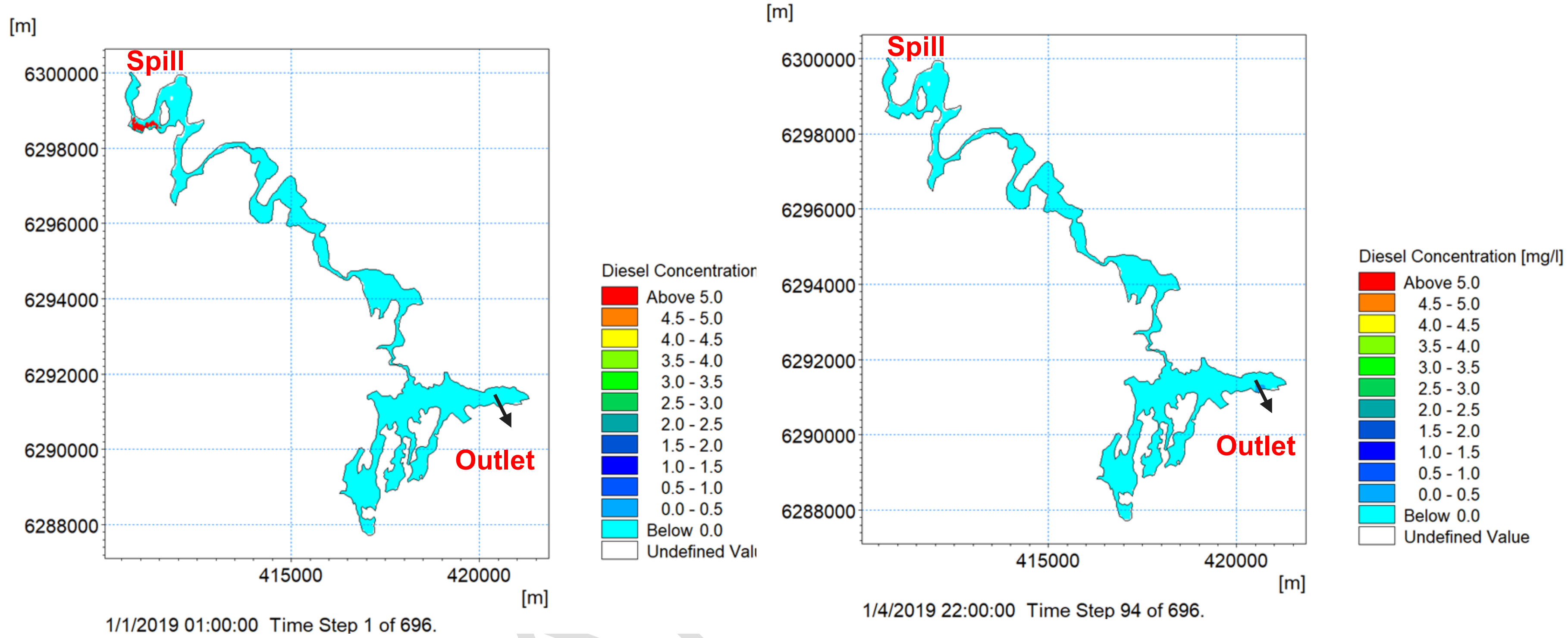


Figure 7-8 **Scenario 2 – Gordon Site Diesel Concentration Results: At Beginning of the Spill (Left) and 4 Days After the Spill (Right)**

7.3.3 Scenario 3 – High Flows

Figure 7-9 shows the diesel concentration at the beginning, and 21 hours after the spill. The maximum initial concentration of diesel was 1617.36 mg/l (see Figure 7-9). According to Figure 7-7, Figure 7-8, and Figure 7-9, the increased water level and flow rate increased assimilative capacity and therefore the mixing rate of diesel with water, which reduced the initial plume concentration compared to scenarios 1 and 2. The plume dispersion into the lake increased compared to scenario 2 (see Figure 7-8). The plume dispersion pattern was different compared to scenario 1, with a higher plume concentration at the Outlet (see Figure 7-7). The maximum diesel concentration in the lake was 393.99 mg/l after 17 hours of the spill. Shown in Figure 7-9, the maximum plume concentration reached to 27.49 mg/l at the outlet after 21 hours.

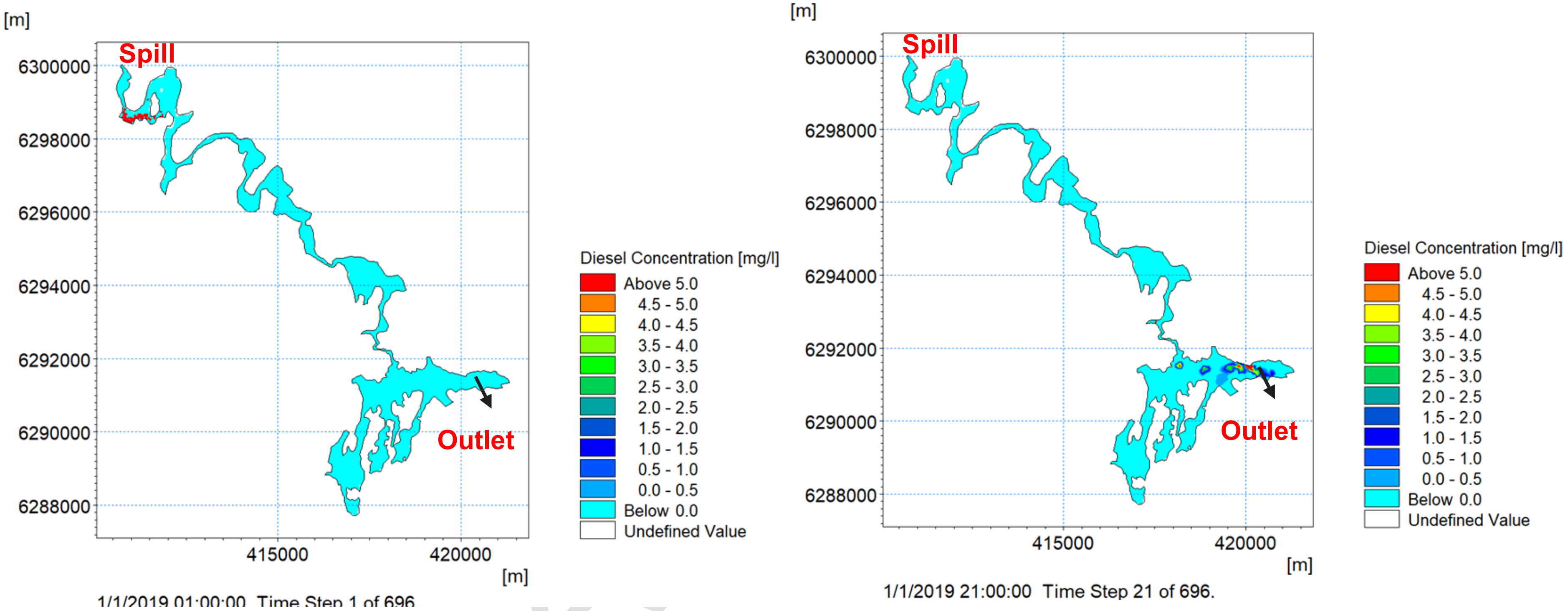


Figure 7-9 Scenario 3 – Gordon Site Diesel Concentration Results: At Beginning of the Spill (Left) and 21 Hours After the Spill (Right)

8.0 Summary of Findings

The potential environmental effects of the accidental spills of diesel, sodium cyanide, and ammonium nitrate (solid and emulsified forms) on the water quality of rivers and lakes were evaluated under three modelling scenarios for the MacLellan and Gordon sites. Cyanide, diesel, ammonia, and nitrate are not expected to persist in the environment, nor result in potential bioaccumulation. Diesel may attach to nearshore and shoreline vegetation and shallow sediments, and thus, the potential exists for some further persistence of diesel in the environment. None of the fate and behaviour modelling scenarios considered spill response, particularly for diesel, where the deployment of spill diversion, collection and sorbent booms and product recovery would be reasonably implemented. Thus, the modelling is considered to be conservative and represent a worse-case condition.

For the MacLellan site spill:

- In scenarios 1, 2, and 3, the initial total maximum concentration of the cyanide is above the MDMER and CWQG-FAL limit, the initial total maximum concentration of the ammonia is below the MDMER and above the CWQG-FAL limit.
- In scenario 1, the total maximum concentration of cyanide in the lake is above the MDMER and CWQG-FAL limit, but in scenario 2 and scenario 3, the total maximum concentration of cyanide is below the MDMER and above the CWQG-FAL limit.
- For all three scenarios, the total maximum concentration of cyanide at the lake outlet is below the MDMER and above the CWQG-FAL limit,
- For all scenarios, the total unionized ammonia is below the MDMER and CWQG-FAL limits in the lake and outlet, but unionized ammonia is above the CWQG-FAL and below the MDMER limits at spill location.
- In scenarios 1, 2, and 3, the initial maximum concentration of total initial nitrate concentration is below the short-term CWQG-FAL limit, but above the long-term CWQG-FAL limit. The plume reached the Cockeram Lake outlet which was below short-term and long term CWQG-FAL limits. The dispersion pattern of nitrate followed the same behaviour as cyanide.
- No MDMER and CWQG-FAL concentration limits are reported for diesel. The dispersion pattern of diesel followed the same behaviour as nitrate and cyanide.

For the Gordon site spill:

- In all scenarios, nitrate and ammonium concentrations resulting from dissolution of ammonium nitrate emulsion were reduced notably at the lake outlet.
- In all scenarios, the total maximum concentration of nitrate is below the short-term and long-term CWQG-FAL limit.
- In all scenarios, the total maximum concentration of ammonium is below the MDMER and above the CWQG-FAL limit.
- No CWQG-FAL limits are defined for diesel. The diesel concentration was reduced substantially at the lake outlet.

9.0 REFERENCES

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A.33 ATTACHMENT IAAC-145

Stantec

Memo

To: Karen Mathers, P.Geo.

Stantec, Winnipeg

From: Seifu Guangul, P.Eng.
Dave Morgan, P.Eng.

Stantec, Winnipeg

File: 111440362.

Date: July 12, 2016

Reference: Result of Flood Risk Assessment for Lynn Lake Gold Project Proposed Mine Sites

OBJECTIVE: This memo provides a summary of the methods and results for determining the peak flood elevations for waters adjacent to the proposed pits for each of the MacLellan and Farley Lake mine sites. Water elevations associated with floods having return periods of 25- and 100-years were considered in the analysis as requested by Golder Associates Ltd. on June 15, 2016.

SUMMARY OF METHODS: Two methodologies were used to estimate peak flood elevations for each site due to each site's physiographic differences.

MacLellan Mine Site

The MacLellan Mine site is adjacent to the Keewatin River (**Map 1**; attached). The Keewatin River at the assessment location is approximately 200 m wide. The watershed area upstream of the Keewatin River assessment point is approximately 1,330 km^2. The methods used to estimate the elevations at the MacLellan Mine site included the following:

- Design flows were developed based on regional flood frequency using available Water Survey of Canada (WSC) flow stations. The following steps were carried out as part of this analysis:
  - Streamflow stations from WSC, in and around the hydrology study area, were first identified. The table below shows list of stations identified:

Station ID	Station Name	Drainage Area (km^2)
06DA002	Cochrane River Near Brochet	28,400
06EB003	Barrington River Above First Rapids	1,760
05TF002	Footprint River Above Footprint Lake	643
05TG006	Sapochi River Near Nelson House	391

  - Gumbel frequency distribution, which is recommended by Environment Canada (Millington et al. 2011), was fitted to each individual WSC station. The distribution was then used to derive the 25- and 100-year events from each station. **Figure 1** provides an example of such analysis (Sapochi River near Nelson House).
  - Regression relationships were developed for each return period event between flood values at a specified return period from each streamflow station versus the watershed area upstream of each WSC station. **Figure 2** provides an example of this relationship for a 100-year event.
  - The regression relationship was then used to estimate design flows for the Project site at the specified return periods using the watershed area upstream of the assessment location.

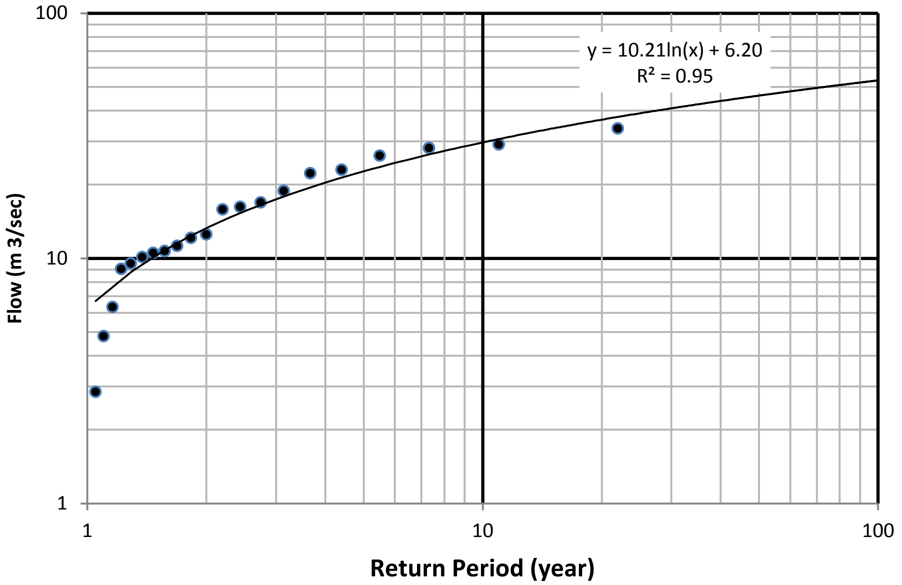

Figure 1: Flood Frequency Curve for Sapochi River near Nelson House

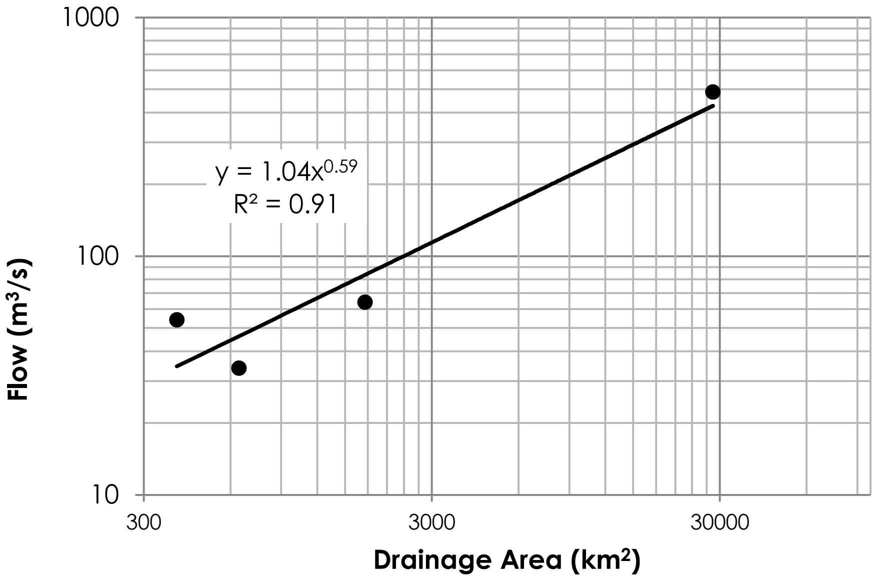

Figure 2: Regional Flood Frequency Curve for 100-Year Event

- River cross-sections were extracted from a combination of bathymetry and LiDAR data for use in a HEC_RAS Model.
- A HEC-RAS hydraulic model was setup to determine water surface elevations associated with the design flow events. The model was first calibrated to known discharge and water level data collected in 2016 and then run using the 25- and 100-year return period flows.

Farley Lake Mine Site

The assessment location for the Farley Lake mine site is on Farley Lake at the interface with the proposed pit (**Map 2**; attached). The watershed area upstream of the Farley Lake assessment point is 13.3 km^2.

Because the contributing area to Farley Lake is substantially less than the watersheds used to develop the regional flood frequency (RFF) relationship for the MacLellan mine site, a different method was required. An addendum to the Flood Damage Reduction Program (FDRP) guideline from Environment Canada (Environment Canada 1980) does not recommend the use of the RFF method where watershed areas associated with the assessment location are substantially lower than the watersheds areas used to develop the RFF relationship. Rather, under such a condition, a precipitation-runoff model is recommended to be used. This was the method of flood estimation selected for the Farley Lake mine site. The following steps were carried out for Farley Lake:

- US-SCS Technical Report 55 (TR-55) approach was used to determine the average time of concentration of the contributing watershed (average time determined was 6 hours).
- 25- and 100-year design rainfall depths were estimated from Intensity-Duration-Frequency (IDF) curves at the Lynn Lake Airport. This is the closest station to the Farley Lake mine site. The 6-hour 25- and 100-yr storm depths were 48mm and 60mm, respectively.
- The 25- and 100-year storm depths were distributed according to a SCS type II distribution. Professional judgment was used to select this method.
- A watershed model (HEC-HMS) was developed to determine inflows into Gordon and Farley lakes. All flows into Gordon Lake were assumed to be transferred immediately to Farley Lake via a bypass channel.
- A conservative assumption was taken in the model, whereby no outflow from Farley Lake was assumed to occur.
- The storage-elevation relationship for Farley Lake was developed from bathymetry and LiDAR data.
- It was assumed that, prior to the storm event, Gordon Lake was at its full capacity, meaning all additional runoff was routed directly to Farley Lake (i.e., no storage or attenuation of the design storm was accounted for in Gordon Lake). In addition, it was assumed that the initial level of Farley Lake was 314m, which is about half a meter above the water level determined at the time of the 2016 bathymetry data.

RESULTS

MacLellan Mine Site

Table 1 shows the results for the flood risk assessment at the MacLellan mine site, which indicates that the water level elevation changes are not sensitive to very large changes in flows. This is due to the large channel capacity in the Keewatin River near the assessment location (i.e., near the proposed pit).

Table 1: Summary of Peak Flood Elevation for Keewatin River at the MacLellan Mine Site Assessment Location

Return Period	Flow (m^3/sec)	Peak Flood Elevation (m ASL)
1.5 (2016 field measurement)	8	330.8
25-year	53.1	331.8
100-year	72.5	332.3

Figures 3 and 4 provide supplementary HEC-RAS results for this site.

Farley Lake Mine Site

Table 2 summarizes the results of the Farley Lake simulation. The results indicate that there are only small changes in water surface elevations associated with substantial changes to lake inflows.

Table 2: Summary of Peak Flood Elevation for Farley Lake at the Farley Lake Mine Site Assessment Location

Return period	6-hr Precipitation (mm)	Estimated Inflow to Farley Lake (1,000 m^3)	Peak Flood Elevation (m ASL)
Assumed initial elevation of Farley Lake prior to storm= 314 m			
25-year	48	281.1	314.3
100-year	60	407.3	314.4

Figures 5 and 6 provide supplementary HEC-HMS model results for this site.

LIMITATIONS

The primary objective of this analysis was to provide conservative estimates of peak flood elevations at both mine sites. Several simplifications were made in this analysis starting from design flood estimation, model setup and initial conditions. Actual operation of Gordon Lake, Farley Lake and hydraulic capacity of the diversion channel that connects both lakes were not taken into consideration and are beyond the scope of this work. However, this and other similar tasks can be carried anytime in the future if required.

Freeboard has not been added to the peak flood elevations presented herein. Freeboard, to consider uncertainty and wave action, should be evaluated by the design engineer(s).

CLOSING

If you have any questions or concerns, please do not hesitate to contact us.

Stantec Consulting Ltd.

Seifu Guangul, Ph.D., P.Eng
Associate and Senior Water Resources Engineer

Dave Morgan, Ph.D., P.Eng
Principal and Senior Water Resources Engineer

c. Sitotaw Yirdaw-Zeleke

Assessment Independently Senior Reviewed by David Luzi, Ph.D.

REFERENCES

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Reference: Result of Flood Risk Assessment for Lynn Lake Gold Project Proposed Mine Sites

Figure 3: Estimated water surface profile for Keewatin River based on 25-year event

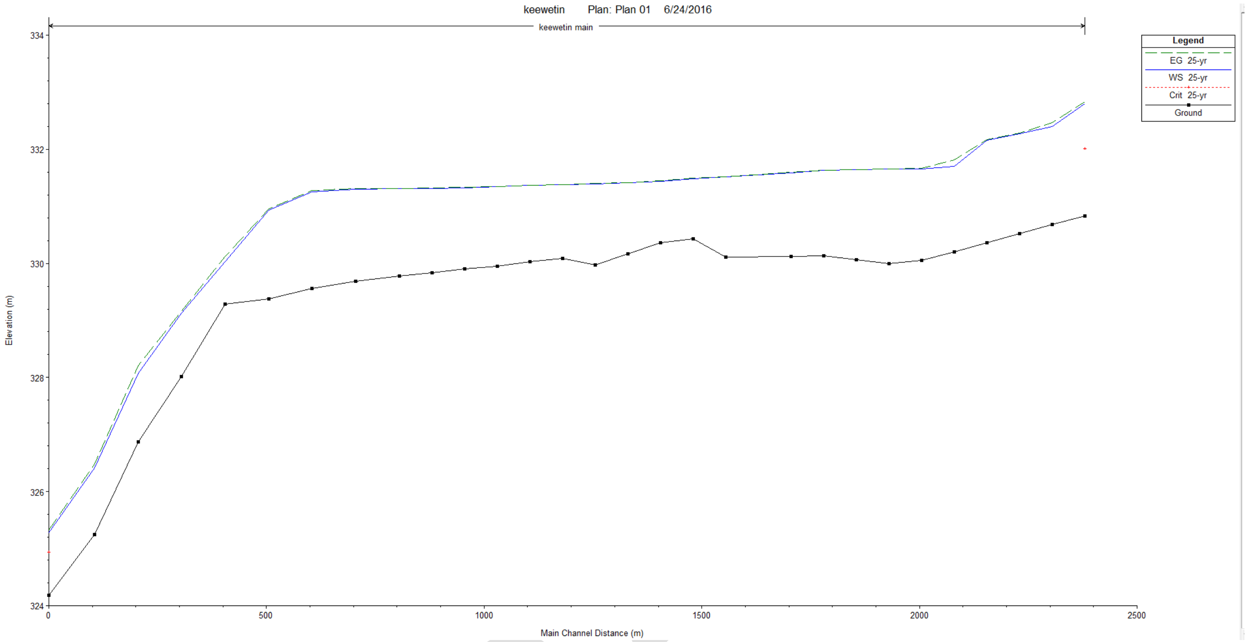


Figure 4: Estimated Water Surface Profile for Keewatin River based on 100-year event

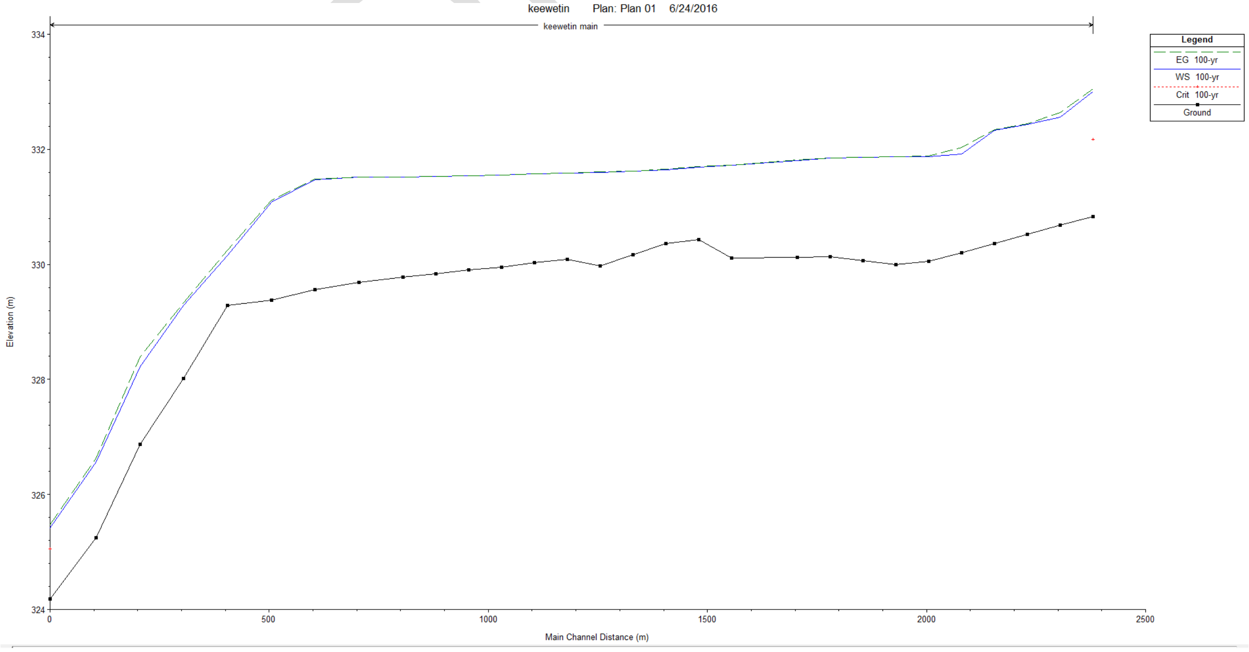


Figure 5: Estimated Inflow, Storage Volume and Elevation for Farley Lake based on 25-year event

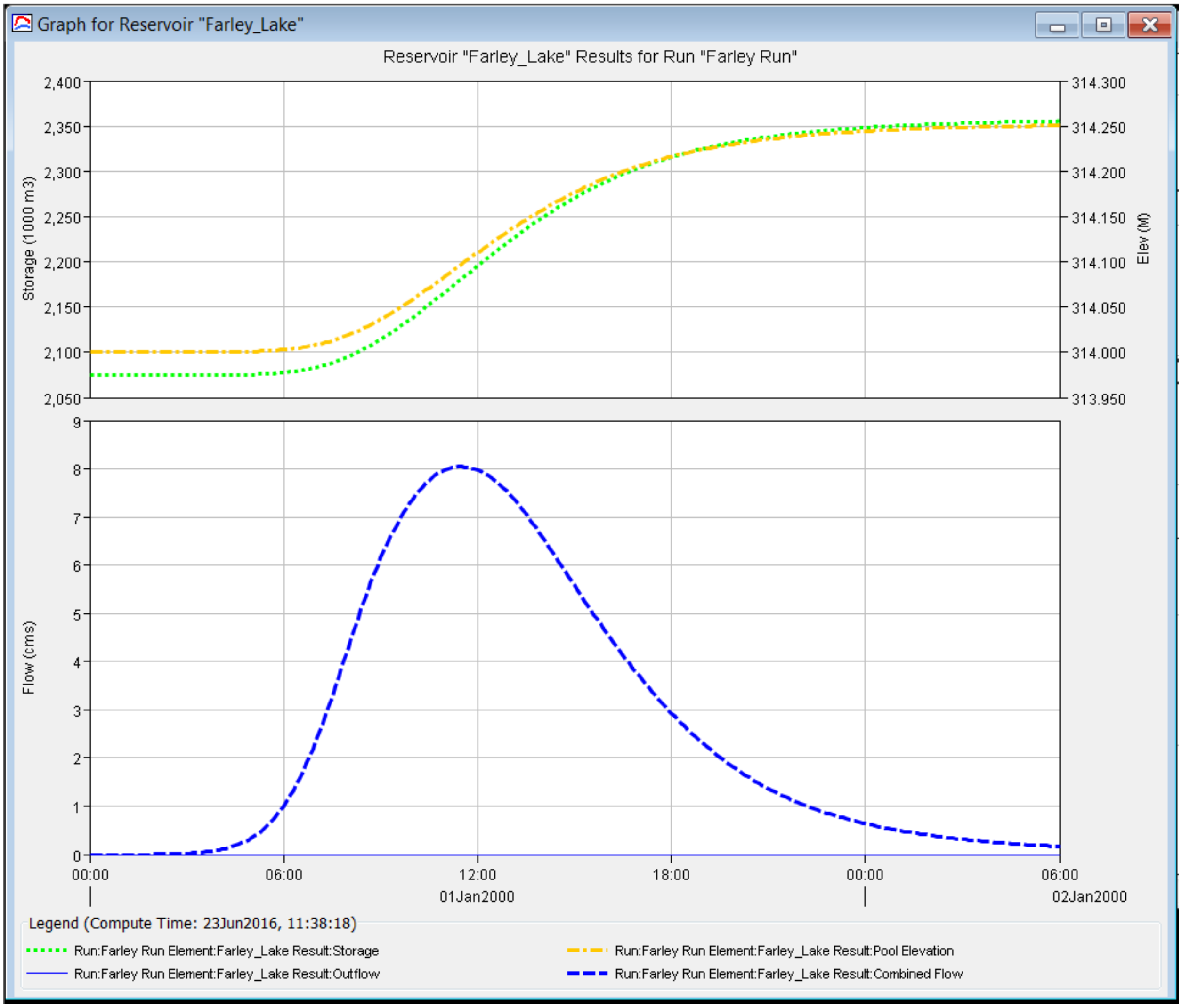
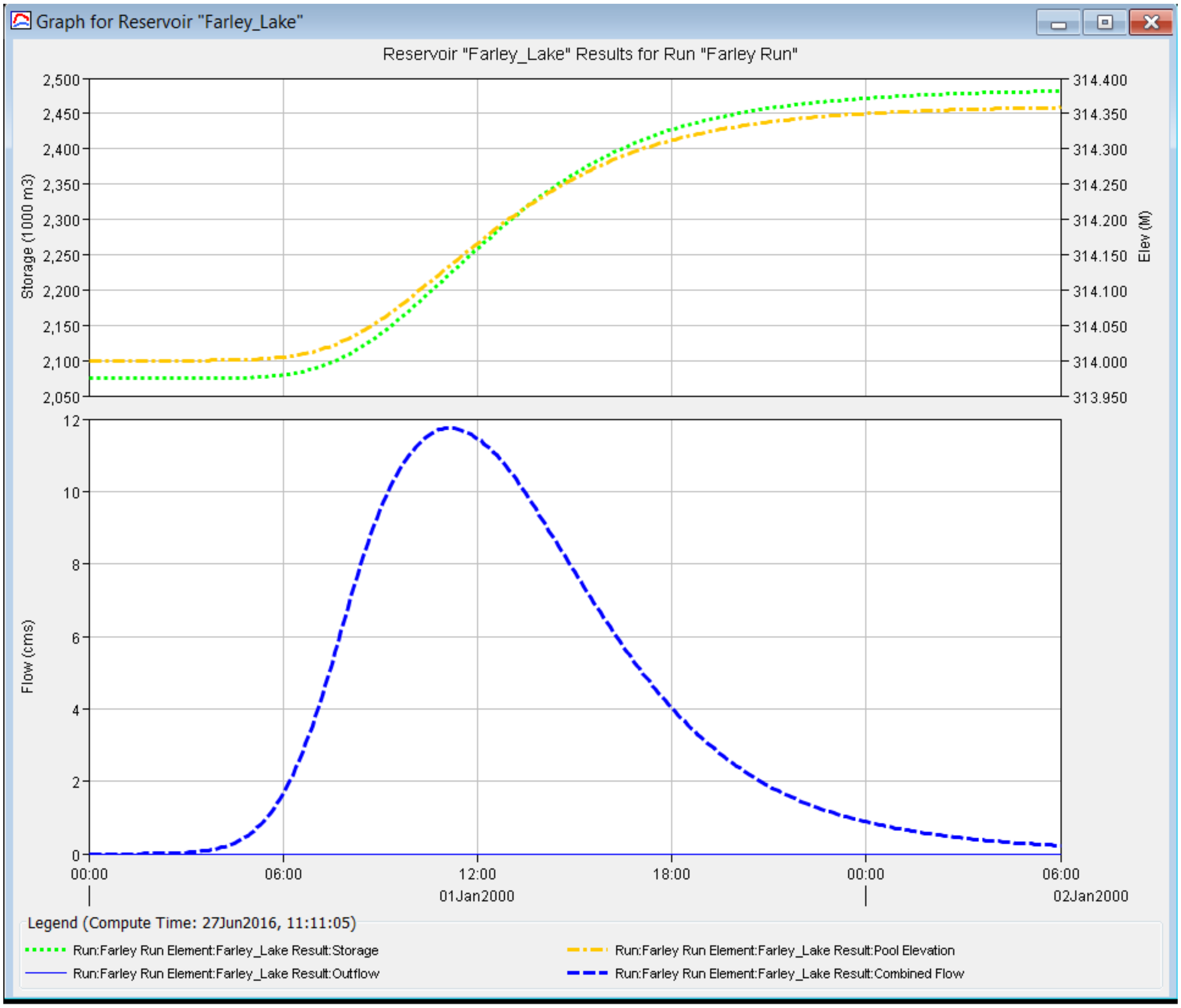
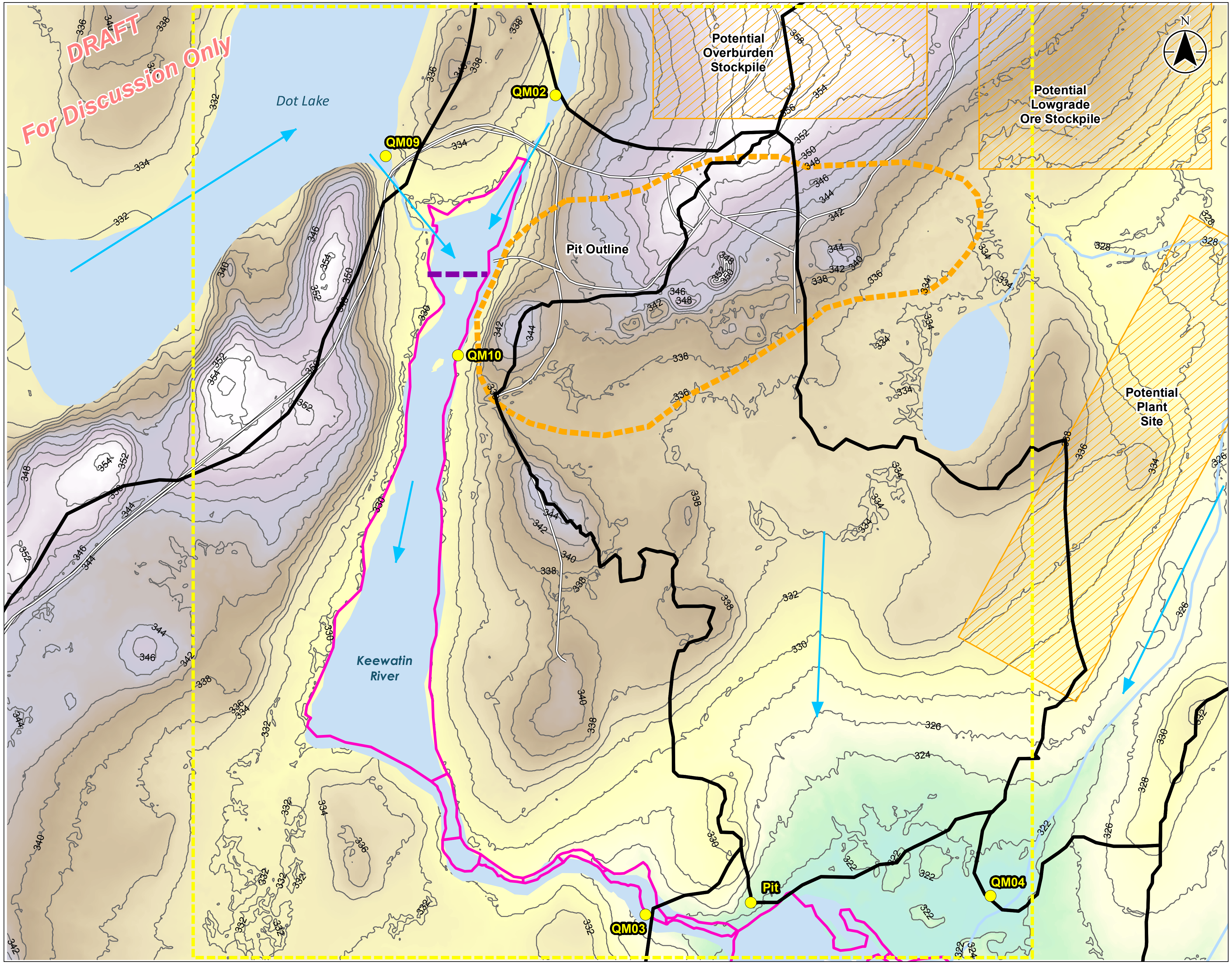


Figure 6: Estimated Inflow, Storage Volume and Elevation for Farley Lake based on 100-year event





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Project Infrastructure

- ▭ Pit Outline
- ▨ Potential Infrastructure

Sample Locations

- ● Subwatershed Outlets
- ▬ ▬ Assessment Location
- ▭ Keewatin River Bathymetry Coverage Area

Study Area

- ▭ Subwatersheds
- ▭ Model Domain Boundary

Landbase

- ═ Access Road
- — Watercourse
- → Surface Water Flow Direction
- — Ground Elevation (m)

Elevation (m)
High : 360
Low : 320

0 250 500 Metres
1:9,000 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base features provided by the Government of Manitoba and the Government of Canada.
3. Imagery: SPOT-7 imagery, BlackBridge Gemoatics Corp. July 2015.

Project Location 11440362
MacLellan Site
Lynn Lake, Manitoba

Client/Project
2016 LYNN LAKE GOLD PROJECT
ENVIRONMENTAL BASELINE STUDIES

Map No.
1

Title

Keewatin River Bathymetry Coverage and Sub-Watersheds Near MacLellan Mine Site

Page 01 of 01

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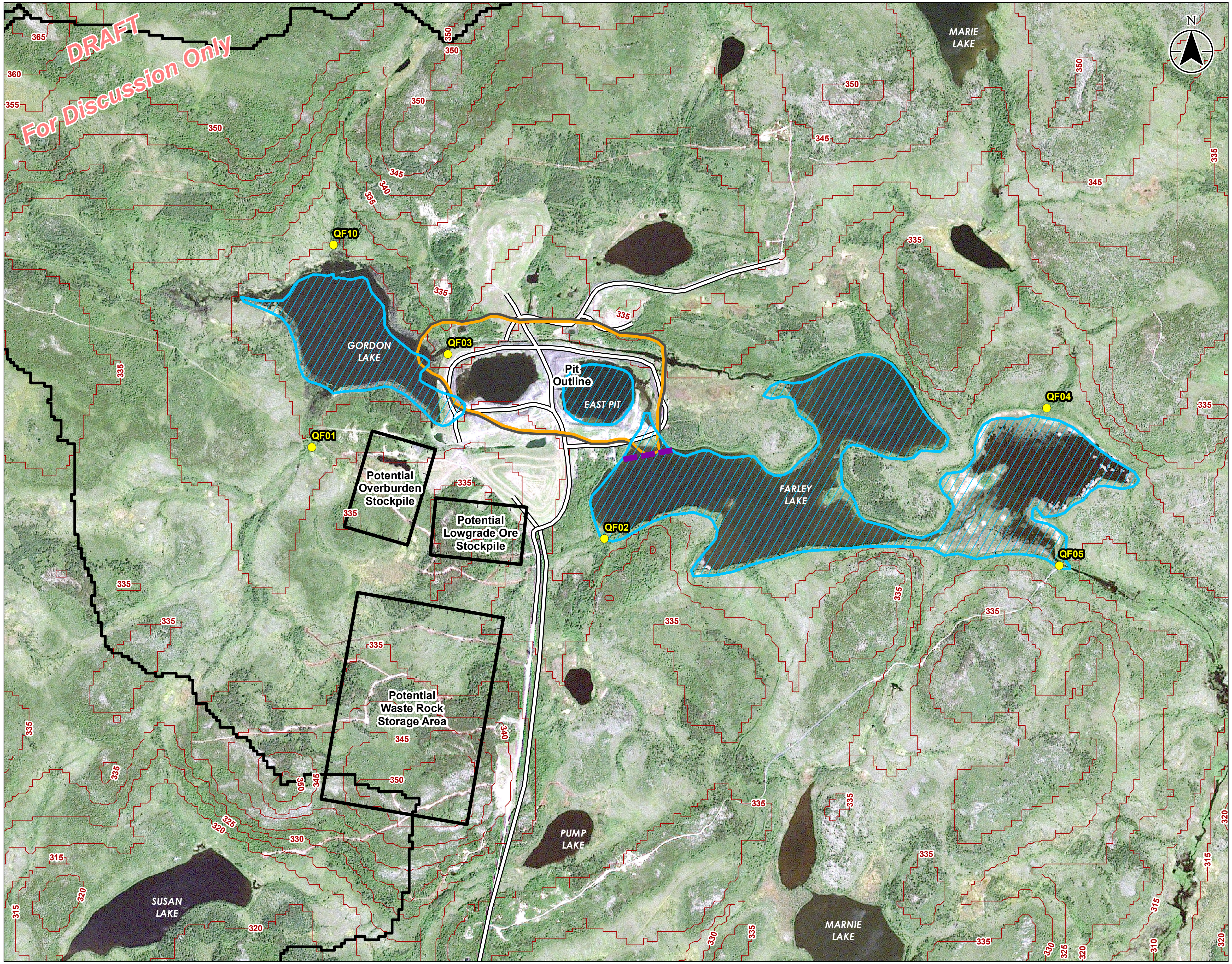

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Project Infrastructure
🟧 Pit Outline
☐ Potential Infrastructure

Study Area
☐ Subwatersheds

Survey Locations
● Hydrology Monitoring Sites
▬ ▬ Assessment Location
▨ 2015 Bathymetry Monitoring Areas

Landbase
— Elevation Contours (m)
═ Access Road

0 400 800 Metres
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Notes
1. Coordinate System: NAD 1983 UTM Zone 14N
2. Base features provided by the Government of Manitoba and the Government of Canada.
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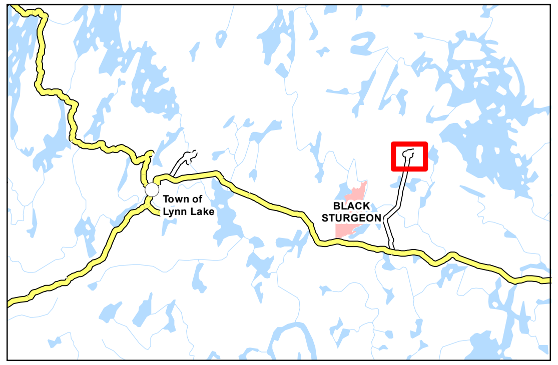

Project Location 11440362
Farley Lake Site
Lynn Lake, Manitoba

Client/Project
LYNN LAKE GOLD PROJECT
ENVIRONMENTAL BASELINE STUDIES

Map No.
2

Title
Locations of Bathymetry Surveys
Farley Lake Mine

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