Joint Review Panel Request for Additional Information Response Package Addendum 10

Package 1: Air Quality and Noise

Benga Mining Limited
Grassy Mountain Coal Project

July 2019

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AIR QUALITY

1.1 Information Request 1.1

Grassy Mountain Coal Project - Updated Environmental Impact Assessment. Section C – Project Description. (CEAR #42).

Coal from the project will be transported in 14,000 tonne loads by rail car, and will remain uncovered along its 1,100 km journey to port.

In the Project Description, under section C.3.2.1 (CEAR #42), Benga states that the metallurgical coal loadout into train cars "also sprays a latex binder solution over the top of the coal load to minimize release of dust as the train travels to port". Benga has not provided details relating to the latex binder solution, including its efficacy in minimizing dust release during transport.

a) Provide reference material relating to the latex binder solution, including manufacturers' documentation, studies relating to the efficacy of the binder, WHMIS documentation, and any other relevant documents including, if available, appropriate references to published studies respecting experience in the practice of the application of latex solution to coal loads as a coal dust mitigation measure.

Response:

i) Product and Project specific information

Benga will use the Envirobind DCT product which performance is described in Appendix 1.1-1. The MSDS sheet is also provided in Appendix 1.1-2.

Benga, through its engineering contractor Sedgman Ltd, has commissioned Engineered Chemical Solutions (ECS) to determine the capabilities of the product Envirobind DCT in mitigating coal dust during the transportation of clean coal product *via* rail from Blairmore to Westshore Terminals in Vancouver, a distance of about 1100 km. A report titled "Car Topper Evaluation on Riversdale Coal Report" (ECS 2018) is provided in Appendix 1.1-3, which outlines the results of the assessment.

ECS (2018) concluded after a series of tests (full methodology and results provided in Appendix 1.1-3) that significant improvement in dust suppression for the entire trip from mine (Blairmore) to port (Vancouver) can be achieved by increasing dosage from standard dosage up to three (3) times standard dosage of Envirobind DCT, which is approximately 90 kg per 152-unit train.

ii) Literature review

According to the Envirobind DCT manufacturer, most products used to treat railcars are "toppers" or substances like latex that coat the top layer of coal, or surfactants that act as a wetting agent. Envirobind DCT is a cross-linked biopolymer with a surfactant that binds with the coal to form a crust layer (see photo in Appendix 1.1-1). Test results suggest this product is at least a good as the topper products examined in the literature below.

Kotchenruther (2013) of the U.S. EPA examined fugitive dust emissions in response to public concern. He found the main factors affecting fugitive dust emissions were car and load geometry (rail car dimensions, coal load profile, and total exposed surface area of coal), the physical properties of the coal (coal moisture content and size distribution), trip specifics (train speeds throughout route, load jostling in route, total journey length, and weather encountered: wind, precipitation, temperature), and dust controls (control measure effectiveness and percent remaining at end of journey).

In 2010, Burlington Northern Santa Fe Railway (BNSF) and Union Pacific conducted a field evaluation of coal dust suppressant technologies using trackside and train-board aerosol monitors (BNSF 2010). More than 85% dust suppression was achieved following load profile guidelines and applying a topper agent to loaded coal.

Kotchenruther (2013) noted 0.5% to 3% of total coal transported is lost through fugitive dust when there are no dust control measures. Wind tunnel experiments (from 1983) have estimated losses on the order of 0.9 to 1.8% for a 1100 km journey.

Cope and Bhagacharyya (2001) developed an estimation approach for TSP emissions from rail transport of coal. The equation for TSP (kt/t) = $0.1*(0.62*D)^{0.6}$, where D = total distance travelled by rail cars (km), gives 0.5% coal loss over a 1100 km transit for uncontrolled coal dust losses.

OEA (2015) summarized several studies on coal dust emissions from rail:

- A U.S. rail industry study estimated that a train operating under clear, dry, sunny conditions lost between 0.17% (shaped profile) and 0.34% (unshaped profile) of the total coal load, with no use of topper agents.
- Rail cars with tops partially covered by mechanical cover lost less than 0.001% of the loaded coal over a 350-km trip with an average speed 50-60 km/h (Portugal).
- A mathematical model predicted the emission of TSP-sized coal dust from trains in Queensland Australia. The model estimated that without a topping, these rail cars would lose an average of 0.0035% of their total load. For cars carrying 90 t of coal, this amounted to about 2.7 kg of coal dust lost per car, over trips of 150 and 500 km in length.

Further, OEA (2015) concluded that coal dust from trains on the proposed rail line would not harm human health or the environment. OEA predicted the potential concentration of coal dust in the air and found that it would be below the standards set in the National Ambient Air Quality Standards and the Montana Ambient Air Quality Standards to protect human health.

b) Estimate the percent efficacy of the latex binder solution in mitigating dust release during transport. Discuss whether the binder solution will remain effective throughout the entire journey to port.

Response:

As stated in part a), ECS (2018) concluded that significant improvement in dust suppression for the entire trip from mine (Blairmore) to port (Vancouver) can be achieved with a dosage of up to three (3) times standard dosage of Envirobind DCT. ECS (2018) found that this treatment rate results in a particulate loss of 0.09%, as determined by vibration and wind tunnel tests. The duration of testing and the relationship of the test duration and intensity was based on their previous experience with long-haul coal trains from Elk Valley (located immediately west of the Crowsnest Pass) to Vancouver.

In addition, the manufacturer has committed to working with Benga's engineers to develop the spray applicator unit for the Grassy Mountain loadout, to provide guidance on the "make down" unit that mixes the dry product with water for on-site storage and then further mixes it during application, and to monitoring and optimization of the treatment amounts on-site.

The monitoring program recommended by the manufacturer includes the following:

- Installation of continuous particulate monitoring on select rail cars during the first several trips to the port;
- Installation of "Go-Pro" cameras on the rail cars linked to GPS to monitor visible dust;
- Correlation of dust measurements with geographic or wind features on the trip, to identify problem areas; and
- Monitoring *via* camera for visible dust at the port of Vancouver.

c) Identify the impacts of precipitation and/or high wind speeds during the application of the binder solution and while the coal is in transport to port.

Response:

The ECS (2018) report included a wind tunnel test at speeds of 100 km/h. The efficacy estimates noted in the response to Part b) included the wind tunnel operation.

Rain limits loss regardless of topper application (OEA 2015). According to the Envirobind DCT manufacturer, rain can enhance dust control, as the rain re-activates the DCT in the material crust and produces greater penetration of the binder into the coal.

References:

BNSF. 2010. Summary of BNSF/UP Super Trial 2010. http://www.swcleanair.org/docs/coaltrains/BNSF%20Coal%20Dust%20Super-trial.pdf

Cope and Bhaoacharyya, 2001. A Study of Fugitive Coal Dust Emissions in Canada, An Unpublished Report Prepared for the Canadian Council of Ministers of the Environment. Referenced by Kotchenruther (2013).

Engineered Chemical Solutions (ECS) - Power Chemicals. 2018. Car Topper Evaluation on Riversdale Coal Report. 6 pp.

Kotchenruther, Robert. 2013. Fugitive Dust from Coal Trains: Factors Effecting Emissions & Estimating $PM_{2.5}$. EPA Region 10, NW-AIRQUEST 2013. http://lar.wsu.edu/nw-airquest/docs/201306_meeting/20130606_Kotchenruther_coal_trains.pdf

Surface Transportation Board Office of Environmental Analysis (OEA). 2015. Chapter 6 Coal Dust. In Draft Environmental Impact Statement for the Tongue River Railroad. https://www.stb.gov/decisions/readingroom.nsf/UNID/E7DE39D1F6FD4A9A85257E2A0049104D/$file/Ch06_Coal+Dust.pdf

1.2 Information Request 1.2

Grassy Mountain Coal Project - Updated Environmental Impact Assessment. Section C – Project Description. (CEAR #42).

Grassy Mountain Coal Project - Updated Environmental Impact Assessment. Consultant Report #1 – Air Quality. (CEAR #42).

Benga has proposed placing the Project rail loadout adjacent to Highway 3 and across from the town of Blairmore, AB. Highway 3 is an important thoroughfare in southwestern Alberta and deposition of coal dust can be both an aesthetic and safety issue. In addition, the proximity of the rail loadout to Blairmore has raised concerns relating to coal dust deposition.

In the Project Description, under section C.2.12 (CEAR #42), Benga states that the "train loadout bin (BN-852) will be fully enclosed with an external cladded shed structure as shown in Figure C.2.12-1" however, figure C.2.12-1 only provides a simple schematic of the train loadout cladding arrangement. Benga has identified the rail loadout structure as the primary means of minimizing fugitive dust generation from the rail loading activity, however no details with respect to the dimensions of the train entry and exit or the overall length of the loadout structure are provided.

Section 6.6 of the Consultant Report #1 (CEAR #42) indicates that "fugitive dust generation will be minimized at the rail load-out, with full cladding on the sides of the load-out structure to create a wind shelter". Benga identifies that full cladding will be used on the sides of the loadout structure but it is not clear if structure will have a fully enclosed roof.

Section 4.1 of the Consultant Report #1 (CEAR #42), clarifies that "the movable discharge chute of the coal bin will be located as close as practical to the coal within the rail cars to minimize the drop height of the coal" in order to minimize the rail loadout fugitive dust emissions. Although Benga is proposing the moveable discharge chute as a mitigation measure, the EIS does not evaluate the physical profile of the exposed coal above the sides of the railcar and its susceptibility to wind during transport.

a) Confirm that the rail loadout structure includes a fully enclosed roof.

Response:

The train loadout (TLO) system will be a fully enclosed (including roof), automated system designed to efficiently and reliably load the clean coal product into train cars for transport. Photos 1.2-1 and 1.2-2 illustrate an existing TLO system (*e.g.,* Bengalla Mine, Australia), that is similar to the TLO system being proposed for the Project.

Photo 1.2-1 The existing Bengalla Mine (Australia) TLO System.

Photo 1.2-2 Bengalla Mine (Australia) Metal Cladded TLO structure, illustrating the enclosed roof. The proposed TLO for the Grassy Mountain Coal Project will have a similar configuration and enclosed roof.

b) Provide the proposed dimensions of the rail loadout cladding structure.

Response:

Figure 1.2-1 provides the conceptual drawing of the TLO cladding structure. In general, the TLO is made up of two main structures with the vertical bin section that connects to the overland conveyor being approximately 30 m tall and 8 m wide and the horizontal train car entry and exit sheds (on either side of the vertical bin section) being approximately 38 m long and 8 m wide. Additional secondary infrastructure such as stairs will also be attached the TLO structure on the exterior of the all-weather metal cladding.

c) Evaluate the efficacy of the rail loadout structure in minimizing fugitive dust; include consideration of the effect of structure openings during coal loading activity.

Response:

The proposed TLO system is based on designs that have been constructed and are in current operation at other coal mine facilities with stringent air quality requirements to mitigate effects to the neighbouring communities (*e.g.,* Bengalla Mine, Australia). Loading efficiency is a key focus with the TLO design, as along with minimizing any economic loss of product, the intent of the TLO design is to minimize fugitive coal dust emissions as well as the spilling of coal within or outside the structure.

To load trains, a loading bin will be mounted over the rail track. The system is a well proven arrangement used to load coal trains at rates up to 4000 train cars per hour. The loading chute will be lowered to a level whereby the loading of the coal train car is “choke fed” which means that the coal is not falling through the air but rather direct placement into the rail car. Because the coal is being placed in the car using this method and because the coal is wet with a 10% moisture content when it is placed, there is little chance of dust at the loading point.

As each train car is loaded, the coal surface will be rolled for compaction, then sprayed with a polymer sealer (Envirobend DCT), which will mitigate coal dust during transport to the port. Envirobind DCT is a cross-linked biopolymer with a surfactant that binds with the coal to form a crust layer. This industry accepted approach has proven to be an effective way to transport coal products while limiting any potential fugitive coal dust.

The cladding around the loading operation provides a second barrier for dust emissions. The intent of the cladding from a dust control point of view is not to create an air tight barrier but to provide an additional wind break around the operation. The standard rail car length is 18 to 22 m meaning that the rail car will be entirely within the cladded structure for the entire loading operation.

Photos 1.2-2 (above) to 1.2-4 are examples of the proposed TLO system that have been operating for 10+ years. The lack of coal fines in and around the TLO layout provides a qualitative illustration of the efficacy of the rail loadout structure in minimizing fugitive dust and coal spillage. Figure 1.2-2 provides additional details on the proposed TLO with additional photos illustrating the infrastructure that will be located within the Project’s enclosed TLO.

Photo 1.2-3 Example of existing TLO in operation for 10+ years with lack of coal fines or coal spillage in surrounding area.

Photo 1.2-4 Example of existing TLO facility in operation for 10+ years with lack of coal fines or coal spillage in surrounding environment.

d) Provide justification as to why the structure design, as presented, is adequate to mitigate the potential effects of fugitive coal dust resulting from loading activity on the adjacent highway and town.

Response:

The design proposed by Benga for the rail load out facility is based on proven technology that is in operation at other coal mines subject to rigorous air quality standards and has demonstrated itself to be adequate to mitigate the potential for coal dust emissions. As mentioned in the response above, the evidence of the system's effectiveness is in the photos showing that the area surrounding the load out at Bengalla Mine in Australia is clean and free of coal dust after decades of service with up to 1000 train loadings per year.

In addition, as stated in CR #1b (EIA, CEAR #42), Benga determined that emissions from the activities at the loadout (*i.e.,* locomotive operation and coal car loading) account for a small fraction of total Project emissions. Table 1.2-1 separates the loadout emissions from the overall Project and directly compares them to the existing baseline (community and Highway 3 emissions).

Table 1.2-1 Comparison of Baseline and Loadout Emissions

Sources	Emission Rate (kg/d)					
	SO_2	NO_X	CO	$PM_{2.5}$	PM_{10}	TSP
Loadout	0.2	7.1	13	0.4	7.7	16
Total Baseline	7.6	694	3,821	97	320	1,557
Highway 3[1]	0.84	551	1,865	33	102	481
Communities[1]	6.8	143	1,956	64	219	1,076

[1] as part of baseline

As stated in CR #1b (EIA, CEAR #42), one of the key modelling results determined that the loadout contributions to air quality in the community are generally small fractions of Baseline concentrations and small fractions of the ambient air quality objectives. Benga determined that the loadout operation is expected to produce very little in the way of air quality impacts. It will not result in additional predicted exceedances of ambient air quality objectives beyond those predicted in the Baseline Case.

Based on the emission and dispersion modelling results, the design of the TLO structure as well as the logistics of loading and transport, are adequate to mitigate the potential effects of fugitive dust emissions from loading activity on the adjacent highway and communities. There will not be significant effects related to fugitive coal dust resulting from the Project.

e) Evaluate the change in coal load profile from a fixed height discharge chute to a moveable discharge chute, in relation to the ability of the load profile to resist releasing windblown coal dust during transport.

Response:

Operational data from currently operating TLO systems display that a retractable loading chute provides a more efficient loading process that limits fugitive coal dust emissions. With the ability to lower the chute to a level whereby the loading of the coal train car is “choke fed” it effectively controls potential dust emissions at the load point. Following the loading of the train car *via* the retractable loading chute the product coal is rolled and compacted then sprayed with a polymer sealer (EnviroBind DCT) to contain potential coal dust during transport to port.

A fixed height discharge provides more opportunity for the production of fugitive coal dust emissions during the loading process with product coal being susceptible to wind as it is released from a height above the train car. This is a main reason why the retractable discharge chute is the more favorable option.

Engineered Chemical Solutions (ECS) - Power Chemicals. 2018. Car Topper Evaluation on Riversdale Coal Report. 6 pp.

1.3 Information Request 1.3

Grassy Mountain Coal Project - Updated Environmental Impact Assessment. Consultant Report #1 – Air Quality. (CEAR #42).

In Section 6.5 of the Consultant Report #1 (CEAR #42), Benga "proposes to establish an ambient air quality monitoring program to document the potential, localized, fugitive dust impacts due to Project operation. The measurement program for dustfall will be extended, with details of the required monitoring a function of the operational configuration at any time. As such, the dustfall monitoring program will need to be further developed when the mine plan is established and operations begin, and then modified as mining progresses". As there are uncertainties in how Benga will mitigate and monitor for air quality impacts from the Project a draft air quality mitigation and monitoring plan is required in order for the Panel to assess Benga's ability to effectively detect and minimize impacts.

Provide a draft air quality mitigation and monitoring plan. The plan should include:

a) A description of the potential effects of the Project on air quality that require mitigation,

b) A clear statement of the mitigation objective being pursued and identification of indicators that will be used to determine whether mitigation measures are effective,

c) Details of the proposed monitoring and how the monitoring will measure for Project effects,

d) Thresholds to which monitoring results will be compared to that will trigger the implementation of alternative management actions or mitigation measures, and

e) A description of the technically and economically feasible management actions or mitigation measures that Benga will implement if thresholds are exceeded.

f) A general description of whether, or how, Benga would propose to consider traditional knowledge in the mitigation and monitoring plan.

Response:

The draft air quality mitigation and monitoring plan is provided separately as Appendix 1.3-1.

1.4 Information Request 1.4

Eighth Addendum to the Environmental Impact Assessment. (CEAR #89).

Benga's response to Environmental and Climate Change Canada's (ECCC) question ECCC-R2-5 in Addendum 8 (CEAR #89) provides an update to the $PM_{2.5}$ and TSP modelling predictions to incorporate the "50% control efficiency on haul roads, new emissions at the train load out and the updated regional rail and project locomotive emission". Tables ECCC-R2-5-1 and ECCC-R2-5- 2 summarize the updated modelling results and compare the predicted ground-level concentrations to the original modelling emission scenario, however the summary tables alone do not provide sufficient information to evaluate the spatial air quality impacts from the changes made in modelled emissions scenario.

a) Provide updated $PM_{2.5}$ and TSP isopleths for the update emission scenarios and the appropriate averaging periods.

Response:

The information provided in response to ECCC-R2-5 considered a potential reduction in control efficiency to 50% as an example. Benga remains committed to its target of 80% reduction in dust emissions from treated surfaces.

Nonetheless, as requested, updated $PM_{2.5}$ and TSP isopleths for the emission scenarios and the appropriate averaging periods are presented:

- Update Baseline: including updated regional rail emission;
- Updated Application with 80% Road Control Efficiency: 80% control efficiency on haul roads, new emissions at the train load out and the updated regional rail and project locomotive emission; and
- Updated Application with 50% Road Control Efficiency: 50% control efficiency on haul roads, new emissions at the train load out and the updated regional rail and project locomotive emission.

Figures 1.4-1 to 1.4-6 present updated $PM_{2.5}$ predictions which provide additional spatial coverage beyond the information provided at special receptors. They indicate no exceedances anywhere of the 24-hour AAAQO or CAAQS. They indicate small, localized areas of exceedance of the annual CAAQS of 8.8 $\mu g/m^3$ at a single location in the community in the Baseline scenario, as well as the Application scenario, due to the juxtaposition of road, rail and community sources, and the assumed background concentration of 4.0 $\mu g/m^3$.

Community emissions from the Crowsnest communities, traffic and rail were explicitly included in the model results. In addition, the background concentration measured in a community (Nelson in eastern B.C.) were added to the model predictions. With this double counting, it is expected that annual and daily Baseline and Application predictions in Crowsnest communities near the loadout were overstated. Without the additional overly-conservative background, there were no exceedances of annual CAAQS in Crowsnest communities near the loadout.

Figures 1.4-7 to 1.4-9 present updated TSP deposition predictions (1 mg/100 cm^2 = 1 kg/ha). Predictions in all locations in all emission scenarios are less than the 158 mg/100 cm^2 Alberta guideline for commercial and industrial areas.

Figures 1.4-10 to 1.4-15 present updated TSP concentration predictions for daily and annual averages. Exceedances of the 24-hour and annual AAAQOs are predicted in Baseline and

Application scenarios due in part to the juxtaposition of road, rail and community sources, and the assumed background concentration of 42 µg/m^3. Eliminating the double counting of model and measured background concentrations does not eliminate exceedances.

b) Evaluate the significance of impacts to ambient air quality for areas with increased predicted ground-level concentrations. Update air assessment conclusions, as needed.

Response:

As noted above, the information provided in response to ECCC-R2-5 considered a reduction in control efficiency as an example. Benga remains committed to its target of 80% reduction in dust emissions from treated surfaces.

$PM_{2.5}$:

As noted above, when all locations are considered, not just special receptors, annual average exceedances are predicted. These exceedances are eliminated when the conservative double-counting nature of the modelling is considered, as annual average $PM_{2.5}$ predictions would be reduced by 4.0 µg/m^3.

Alternatively, and more appropriately, the use of model predictions within the same location as the area sources used to model emissions is uncertain. Typically, this is dealt with in modelling by allowing a setback from the area sources, outside of which model results are expected to be valid (*e.g.,* Staniaszek *et al.* 2019). This approach was not used in the current modelling as the community surrounds the loadout and special receptors are scattered within the community. Given this, an appropriate Baseline concentration would be better represented by the background measured in Nelson.

Model predictions of mine and loadout activities, however, are expected to remain valid, as the prediction of these activities are made at the MPB which is set back from the sources themselves. The distance between the loadout and the MPB in that location is considerably smaller than the distance between the mine footprint and the MPB.

The figures indicate the exceedance areas were small and very localized near the loadout facility north across Highway 3 from Blairmore. The predictions are not significant.

TSP Deposition:

As shown in Figures 1.4-7 to 1.4-9, TSP deposition was less than the AAAQG for commercial/industrial areas at all locations on the MPB from mining operations and in the community near the loadout. The predictions are not significant.

TSP Prediction:

Isopleths for TSP daily and annual concentrations are shown in Figures 1.4-10 to 1.4-15. In the Baseline scenario, exceedances of the AAAQO are predicted in communities along Highway 3, due to the juxtaposition of community, highway and rail sources.

For the Updated Application with 80% Road Control Efficiency scenario, the exceedance area increases, but only marginally so in the community. With 50% Road Control Efficiency scenario, project contribution to the TSP daily exceedance area increased substantially near the mine area.

For annual average predictions, exceedances were very localized occurred only in the community south of the loadout. Further, the addition of Project sources had little effect on the area of exceedance in the community and the area was unaffected by road watering efficacy.

The assessment of TSP concentration is conservative. Local emissions of TSP were modelled from road and rail transport and the community, and model limitations when predicting concentrations inside area sources has been identified above. Only natural sources outside the community and industrial sources outside the study area were not modelled and these were accounted for by means of an additive background concentration. Reducing annual and 24-h average TSP predictions by up to 26 $\mu g/m^3$ and 42 $\mu g/m^3$, respectively, is one alternative.

As discussed above, model predictions within the area sources used to represent community, road and rail model emissions are less certain than predictions outside the area sources. Given this, an appropriate Baseline concentration should be the background measured in Nelson, not the measured background added to an uncertain model prediction. Even with this adjustment to model output, it is expected exceedances would be predicted.

It is expected that TSP predictions are conservative for the following reasons:

- The worst-case year of emissions was assessed. These emissions would not be representative of all years of mine operations.
- The mitigative effects of vegetation and small-scale terrain features to physically trap dust have been ignored. Expected concentrations off the mine site are expected to be more than 25% lower than predicted for this reason.
- The effects of generally enhanced turbulence in mountainous areas have not been included. These effects tend to increase dilution of dust plumes and reduce concentrations.
- Annual predictions have not been reduced by the fraction of days with precipitation, which reduces emissions from all activities. This factor would be expected to eliminate annual exceedances.

Currently, an Alberta AAQO and federal NAAQO exist for TSP; however, particle deposition data clearly indicate that the mass of total suspended particles is not an appropriate indicator of particulate matter in relation to human health effects (Environment Canada, 1999). The re-evaluation of particulate air pollution has led to a shift in focus from TSP, which includes a wide size range of particles, to particles equal to or less than 10 micrometers in diameter (PM_{10}), and its subfractions ($PM_{2.5}$) (Health Canada, 1998). This reflects the current belief that the smaller particle fractions are primarily responsible for the observed adverse health and environmental effects. Newer studies indicate an approximately linear relationship between $PM_{2.5}$ concentration and health response (Government of Alberta, 2018). A discussion with Alberta Environment's Senior Ambient Standards Specialist confirmed that the Albertan AAQO for TSP is outdated and is need of revision (L. Blair 2019, personal communication, 1 May).

While exceedances of the AAQO are predicted, the effects are considered to be nuisance effects and the predictions are not considered to be significant form an air quality or human health perspective.

References

Environment Canada. 1999. National Ambient Air Quality Objectives for Particulate Matter Addendum to the Science Assessment Document. The Federal - Provincial Working Group on Air Quality Objectives and Guidelines December 1997, Revised April 1999. Available at: http://publications.gc.ca/collections/Collection/H46-2-98-220-1-9E.pdf [Accessed May 1, 2019].

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1.5 Information Request 1.5

Grassy Mountain Coal Project - Updated Environmental Impact Assessment. Consultant Report #1 – Air Quality. (CEAR #42).

In Figure C4-5 in Appendix C of the Consultant Report #1 (CEAR #42), Benga provides diurnal representation of wind speeds from four air monitoring stations: two on-site and two nearby. The figure indicates that the Project area may experience wind speeds in excess of 12 metres/second however, no evaluation of the potential effects of wind speeds of 89-102 km/hr or above, on dust and particulate matter transport or proposed mitigation is provided.

For high wind speeds between 89-102 km/hr and above provide the following:

a) A quantitative evaluation and assessment of the potential effects of high wind speed on the transport of dust and particulate matter from the Project.

Response:

Benga notes that 1-hour wind speeds in the range of 89-102 km/h (25-28 m/s) have not been recorded at the four stations during the period examined (see response to part b of this question) or in the 2002-2006 AEP MM5 meteorological dataset required for dispersion modelling in the mine permit boundary. Benga also notes that pertinent air quality objectives in Alberta are based on 24-hour averages. Nonetheless the approaches used in the air quality assessment to address emissions in high winds are appropriate for this range as well.

Wind effects on emissions were modelled differently for two source types:

- Wind blown dust; and
- Loading or unloading sources, conveyor drops.

Wind Blown Dust

For wind driven emissions from active areas of operation (aggregate pits, overburden stripping, unpaved haul roads, and from stockpiles), the emission factor formula was obtained from Environment Canada (EC) (2009). Detailed wind driven estimations were presented in Section A4.9 in Appendix A of the Consultant Report #1 (CEAR #42) and are included here.

$$TSP(kg/day/ha) = (1.9)\left(\frac{s}{1.5}\right)\left(\frac{f}{15}\right)$$

$$PM_{10}(kg/day/ha) = 0.5 * TSP$$

$$PM_{2.5}(kg/day/ha) = 0.02 * TSP$$

Where:

s = silt content of the road surface in percentage (%); and

f = percentage of time that the unobstructed wind speed exceeds 5.36 m/s.

"*f*" was assumed to be 100 (%) for these calculations as wind driven emissions were modelled assuming there is no wind driven emission at wind speeds below 5.36 m/s (19.3 km/h). According to U.S. EPA AP 42, the corresponding threshold velocities for piles ranged from 11 to 27 m/s depending on material and location, measured on a 10-m tower (Table 13.2-5.2 in U.S. EPA 2006b). The current approach is conservative to ensure wind driven model emissions are not under-estimated. Precipitation was not considered as a mitigating factor in this calculation.

It is expected the overburden hauling and remediation area will be crusted or covered by vegetation or snow after overburden stripping is complete. Crusting would occur if the area is not disturbed for a period of time. Any natural crusting of the surface binds the erodible material, thereby reducing the erosion potential (U.S. EPA 2006b). Thus, wind driven emissions were estimated based on the approximate actively disturbed area for each operation.

To summarize these effects:

- Windblown emissions from surfaces are a function of the frequency of winds above 5.36 m/s (19.3 km/h), the level at which TSP sized particles begin to move by the wind (siltation). Higher winds at the surface do not result in higher emission rates, according to EC (2009).
- Windblown emissions were based on a wind of 5.36 m/s at a height of 10 m (a standard Environment Canada tower height). A speed of 5.36 m/s at the surface corresponds to winds of 11 to 27 m/s at 10 m. But the model generated dust when 10 m winds were 5.36 m/s, not 11-27 m/s; thus, the frequency of wind-generated dust is overstated in the model.
- In the emissions model, rain was assumed not to mitigate emissions. It was assumed that all surfaces were disturbed every hour and that mining activity was not reduced at night. This also overstates the frequency of wind generated dust.

Thus, the model accounts for wind generated dust conservatively at all observed wind speeds.

Table 1.5-1 compares wind driven emissions on the windiest day to the total emissions associated with mine operation. It indicates wind-driven emissions can account for the majority of $PM_{2.5}$ emissions, on the windiest day.

Table 1.5-1 Comparison of Wind Driven Emissions to Project Daily Emissions

	Sources	$PM_{2.5}$	PM_{10}	TSP
Maximum Daily Emission (kg/d)	Wind Driven Emissions on the Windiest Day, with 24 Hours with Winds Above 5.36 m/s	211	527	1,054
	Maximum Daily Emission for Mine Operation	323	2,834	10,933
	%	65.3	18.6	9.6

While additional emissions do occur at higher wind speeds, and are accounted for in the model, higher emissions do not necessarily result in higher predicted concentrations. In the basic equation C=Q/U where C is predicted concentration, Q is emission rate and U is wind speed. Concentrations are inversely proportional to wind speed, so even though emissions may increase, concentrations do not necessarily increase.

As indicated in response to JRP IR-1.4, no $PM_{2.5}$ exceedances of the 2020 CAAQS were predicted for any averaging period or emission scenario or meteorological conditions at any special receptors, as well as at the Grassy mine permit boundary (MPB).

To examine the wind speeds under which the highest TSP concentrations were predicted, Figure 1.5-1 was prepared, for predictions on or outside the MPB above the TSP AAAQO of 100 $\mu g/m^3$. All exceedances outside the mine permit boundary occurred with 24-h average wind speeds less than 4 m/s and the highest concentrations were associated with lower wind speeds (less than 2 m/s). At all times of year, low wind speeds limit the dilution of dust plumes and strong winds increase dilution. Figure 1.5-1 also shows there were no days in 4 years when winds were above the 5.36 m/s siltation threshold in all hours that led to predicted exceedances.

In conclusion, wind driven emissions were modelled for hourly winds above 5.36 m/s but did not result in the highest predicted particulate concentrations or contribute to predicted particulate matter exceedances outside the mine permit boundary.

Loading and Unloading Operations

Loading and unloading operations are also affected by wind speed. Dust emissions for loading (un-loading) of overburden and coal onto (from) the trucks using backhoes and shovels were calculated based on the maximum annual production rates and emission estimation methodology described in AP 42, Section 13.2-4 (U.S. EPA 2006a) (Aggregate Handling and Storage Piles). This equation could also be applied to conveyor tips.

$$TSP\left(\frac{kg}{tonne}\right) = \frac{0.74 * 0.0016 * \left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}}$$

$$PM_{10}\left(\frac{kg}{tonne}\right) = 0.35 / 0.74 * TSP$$

$$PM_{2.5}\left(\frac{kg}{tonne}\right) = 0.053 / 0.74 * TSP$$

Where:

U = average wind speed in this area (m/s); and

M = moisture content in percentage (%).

The mean wind speed used in the calculations was 3.9 m/s, which was calculated based on 2002 to 2006 CALMET predictions at the site location.

Based on this equation, a doubling of the wind speed would result in an emission increase of $2^{1.3}$ or about 250%. According to the equation C=Q/U, the concentration with a doubling of wind speed decreases by a factor of 2. The net result of emissions increases due to wind for sources affected by this equation, and dilution due to a wind speed increase, is a net increase in concentration of about 50%. For sources not affected by wind – combustion, road dust from wheel entrainment, *etc.* – a doubling of wind speed decreases concentrations by a factor of 2. Given the number of sources modelled in the mine and the differences in dependence on wind speed, the behaviour shown in Figure 1.5-1 is not surprising.

Similarly, a reduction in wind speed by a factor of two leads to a 60% reduction in emissions but a 100% increase due to dilution, for a net increase in predicted concentrations. This is reflected by model predictions and observations of the highest concentrations in light wind conditions.

b) Details of methodology used in the assessing effects of high wind speed events; include an evaluation of the duration and frequency at which that these high wind speed events occur.

Response:

The method for calculating wind-driven emissions and emissions affected by wind speed was summarized in the response to a).

The frequency distributions of high wind speeds (>20 km/h which is approximately the threshold for siltation) at four air monitoring stations are presented in Table 1.5-2 which indicates that wind speeds above 50 km/h or above occurred less than 0.3% of the time (Figure 1.5-2).What is not accounted for in Table 1.5-2 is the difference in measurement height. The on-site measurements were made at a height of about 2 m while the climate station winds are at 10 m. Thus, wind speeds on site would need to be multiplied by a factor (about 1.3 in neutral stability) to scale them to 10 m. This factor has not been applied in Table 1.5-2 because the factor varies with atmospheric stability which was not measured.

Table 1.5-2 Frequency Distribution of High Windspeeds at Four Air Monitoring Stations

Air Monitoring Site	On-Site North Site		On-Site South Site		EC Beaver Mines		EC Crowsnest	
Measured Wind Data Period	2014/07/30 ~ 2014/10/01		2014/06/25 ~ 2014/10/01		2012/02/02 ~ 2014/12/31		2010/01/01 ~ 2014/12/31	
Maximum Wind Speed (km/hr)	35		64		71		52	
Total Count of Measured Hours	1508		2350		25401		43747	
	Count of Hours	%	Count of Hours	%	Count of Hours	%	Count of Hours	%
Wind Speed > 20 km/hr	44	1.9%	572	24%	6746	27%	7150	16%
Wind Speed > 30 km/hr	4	0.2%	199	8.5%	2235	8.8%	1271	2.9%
Wind Speed > 40 km/hr	0	0.0%	43	1.8%	498	2.0%	150	0.3%
Wind Speed > 50 km/hr	0	0.0%	8	0.3%	40	0.2%	3	0.01%
Wind Speed > 60 km/hr	0	0.0%	1	0.04%	2	0.01%	0	0.0%

The frequency distributions of high windspeeds (>20 km/h) at two locations inside the mining area are presented in Table 1.5-3 and indicate that wind speeds 50 - 60 km/h or above occurred about 0.1% of the time. The frequency high windspeeds of modelled CALMET winds and measured winds are similar. Neither measured nor modelled winds approach 89-102 km/h in the mining area.

Table 1.5-3 Frequency Distribution of High Windspeeds at Mining and Dump Area – CALMET Model Wind

	Mining Area		Dump Area	
Modelling Wind Data Period	2002/01/01~ 2006/12/31		2002/01/01~ 2006/12/31	
Maximum Wind Speed (km/hr)	57		62	
Total Count of Modelled Hours	43824		43824	
	5-year Count of Hours	%	5-year Count of Hours	%
Wind Speed > 20 km/hr	8584	20%	10334	24%
Wind Speed > 30 km/hr	1513	3.5%	2099	4.8%
Wind Speed > 40 km/hr	217	0.5%	338	0.8%
Wind Speed > 50 km/hr	23	0.1%	44	0.1%
Wind Speed > 60 km/hr	0	0.0%	3	0.01%

c) Proposed mitigation and management measures specific to dust and particulate matter transport during high wind speed events.

Response:

Model results include predictions in high winds. There are no predicted exceedances of the 24-h AAAQO for $PM_{2.5}$ at any wind speed. Figure 1.5-1 also demonstrates that the highest 24-h TSP concentrations do not occur at the highest wind speeds, although exceedances can occur when 24-h average winds are near 4 m/s (15 km/h).

The following provides information from the draft Air Quality Mitigation and Monitoring Plan (please see response to JRP IR-1.3) for emission sources that are affected by high winds, as well as additional measures not included therein.

Wind Blown Dust from Surfaces:

- Minimize cleared areas to minimize the area susceptible to wind blown dust.
- Coal material handling at coal plant will be *via* covered conveyors.
- Prompt reclamation with overburden and soil from pre-stripped areas, and then covered by vegetation.
- Apply water systematically to haul roads and other accessible areas. Apply water hours in advance of predicted high winds to allow moisture to penetrate.
- Preserve trees and bushes where possible to trap dust. The effective zone of protection created by a windbreak is approximately 25 times its height, although maximum-protection wind reduction occurs in a range of 5 to 8 times the height of the screen (https://dec.alaska.gov/air/anpms/dust/control-techniques-list). Therefore, if planning a windbreak 10 m tall, the windbreak should be located 50 to 80 m upwind of the dust source for maximum usefulness. A 3-m windbreak provides maximum protection to 25 m and some reduction of wind (about 10%) up to 100 m. Except in very specific locations, such as a fixed-location processing plant, the use of vegetation is not a practical solution.

Loading and Unloading:

- use of luffing stackers (those that can lower and raise their boom) at stock piles to reduce the drop height and therefore the period of time the dropping coal is exposed to wind;
- full cladding on the sides of the load-out structure to create a wind shelter; and
- movable coal discharge chute at loadout.

Benga may consider limiting operations during very high wind gust events, which may occur but have not been recorded in any of the available datasets. The conditions under which operations may be limited will be documented and added to the Air Quality Mitigation and Monitoring Plan.

References:

Environment Canada (EC). 2009. *Pits and Quarries Guidance*. http://www.ec.gc.ca/inrp-npri/default.asp?lang=en&n=A9C1EE34-1#s8_8

U.S. EPA. 2006a. *Compilation of Air Pollutant Emission Factors: Volume I Stationary Point and Area Sources.* Part 13.2.4 Aggregate Handling and Storage Piles, Fifth Edition (AP-42). Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

U.S. EPA. 2006b. *Compilation of Air Pollutant Emission Factors: Volume I Stationary Point and Area Sources*. Part 13.2.2 Unpaved Roads, Fifth Edition (AP-42). Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina.

1.6 Information Request 1.6

Eighth Addendum to the Environmental Impact Assessment. (CEAR #89).

Benga summarizes predicted Baseline and Application NO_2 concentrations in comparison to the application of the Canadian Ambient Air Quality Standards (CAAQS) in Table ECCC-R2-6-1 (ECCC- R2-6, Addendum 8, CEAR #89) and states that background values from Lethbridge were applied to Baseline and Application predictions resulting in conservative NO_2 predictions.

The nitrogen dioxide predictions presented in Benga's response to ECCC-R2-6, as well as the predictions presented in the cumulative assessment, show exceedances of the CAAQS at numerous special receptors. Benga has explained these exceedances by noting that predicted baseline concentrations of NO_2 are also in exceedance, and thus account for the majority of predicted NO_2 at most special receptors in the application case. Furthermore, Benga explains these high baseline concentrations by noting that baseline NO_2 values (which are added to model results) are taken from Lethbridge monitoring data, a community with greater expected emissions than the Crowsnest area.

a) Evaluate and explain why some discrete receptors are predicting CAAQS exceedances even with the conservative Lethbridge background concentrations removed.

Response:

The use of Lethbridge background concentrations was to ensure predicted NO_2 concentrations were not under-estimated.

Some discrete receptors were predicted to have CAAQs exceedances, even with the conservative Lethbridge background concentrations removed, for the following reasons:

- at receptors R9 to R13, for 1-hour averages and at the mine permit boundary (not at the community) blasting activities were attributed for the modelled high predictions (Table 1.6-1);
- mobile sources of NOx modelled as a fixed area or as volume sources, can attribute to an overprediction of emissions by a factor of 2 to 5 (Reed and Weston 2005);
- modelling near a roadway or rail line can result in greater uncertainty in predicting concentrations (Staniaszek *et al.* 2019). Staniaszek *et al.* (2019) demonstrated that uncertainty occurs by comparing the results of two models and three source configurations. The study concluded that predictions beyond 300 from the centerline of these sources were largely unaffected by these differences. The Project's model predictions are within tens of meters of these sources and therefore subject to greater uncertainty; and
- predicting concentrations inside area sources representing communities, rather than downwind of them, creates additional uncertainty. This was difficult to avoid in the Project's air quality model, as the sensitive receptors were located inside the community.

Table 1.6-1 Summary of Predicted NO_2 Concentrations (Table ECCC-R2-6-1)

	Updated Rail and Project Locomotive Emissions-2018			
	Baseline ($\mu g/m^3$)	Application ($\mu g/m^3$)	Project Contribution ($\mu g/m^3$)	Project Contribution (%)
98th Percentile Daily Peak 1-hour Concentration[(a)]				
Overall Maximum (MPOI)	122	278	156	56
Mine Permit Boundary Maximum	67	107	40	37
Special Receptor Maximum	118	121	3	2
R1-Campground	88	88	0	0
R2-Trapper's Cabin #1	34	60	26	43
R3-Residential #1	91	91	0	0
R4-Residential #2	33	45	12	27
R5-Residential #3	33	51	18	35
R6-Coleman	103	103	0	0
R7-Frank	89	89	0	0
R8-Blairmore North	118	121	3	2
R9-Aboriginal	46	91	45	49
R10-Residential #4	37	88	51	58
R11-Trapper's Cabin #2	35	92	57	62
R12-Residential #5	40	71	31	44

Table 1.6-1 Summary of Predicted NO_2 Concentrations (Table ECCC-R2-6-1)

	Updated Rail and Project Locomotive Emissions-2018			
	Baseline (µg/m³)	Application (µg/m³)	Project Contribution (µg/m³)	Project Contribution (%)
R13-Residential #6	38	74	36	49
R14-Blairmore Center	94	94	0	0
Annual Concentration[(b)]				
Overall Maximum (MPOI)	51	65	14	-
Mine Permit Boundary Maximum	21	28	7	25
Special Receptor Maximum	47	51	4	8
R1-Campground	26	27	1	4
R2-Trapper's Cabin #1	16	17	1	6
R3-Residential #1	27	27	0	0
R4-Residential #2	16	17	1	6
R5-Residential #3	16	17	1	6
R6-Coleman	38	38	0	0
R7-Frank	31	31	0	0
R8-Blairmore North	47	51	4	8
R9-Aboriginal	18	22	4	18
R10-Residential #4	17	28	11	39
R11-Trapper's Cabin #2	17	19	2	11
R12-Residential #5	17	21	4	19
R13-Residential #6	17	20	3	15
R14-Blairmore Center	36	37	1	3

(a) The 3-year average of the annual 98th percentile of the NO_2 daily maximum 1-hour average concentrations.

(b) The average over a single calendar year of all 1-hour average concentrations

b) Explain why modelled NO_2 predictions can be confidently relied upon in Benga's assessment.

Response:

The Project's predictions are defensible and can be relied on for the following reasons:

- the CALPUFF/CALMET dispersion model used by the Project is recommended by Alberta Environment (Alberta Environmental Protection 2013);
- Standard U.S. EPA emission factors, accepted by regulators (Alberta Environmental Protection 2013), were used to estimate emissions; and

- The model approach followed the Alberta Environment 2013 *Air Quality Model Guideline*, including the standard representation of moving sources as fixed (*e.g.,* along roadways or rail lines).

Notwithstanding the use of recommended procedures, the additional uncertainties identified in the response to a) need to be considered. The Project's NO_2 assessment can be relied upon not to understate NO_2 concentrations in the area.

c) Explain why the modelled predictions remain valid and reasonable if predicted baseline concentrations are unrealistically high, in consideration of the following:

i. Obscuring the true extent of guideline exceedances for both the Baseline and Applications cases;

Response:

As noted above, the Projects predictions are conservative and do not underestimate air quality concentrations of NO_2. This is the basis of the precautionary principle.

The Project's model predictions do not obscure the guideline exceedances, as the predictions taken from ECCC-R2-6 (Addendum 8: CEAR #89) and listed in Table 1.6-1 include the expected contribution of Project sources, as well as those associated with Baseline sources that are acknowledged to have higher uncertainty. Model predictions may overstate the potential for guideline exceedances.

ii. Underestimation of the relative contribution of air pollutants that are attributed to the Project; and

Response:

Predictions in in Table ECCC-R2-6-1 (Addendum 8: CEAR #89) show the contribution of the Project in absolute and relative senses. Table ECCC-R2-6-1 replicated here as Table 1.6-1 clarifies the contribution of the Project to Application predictions in an absolute sense. The Figure 1.6-1 has been provided for ease of reference and identifies the receptor locations. The Project's predictions of the absolute Project contribution at these locations are defensible and can be relied upon. The relative contribution will vary with the Baseline concentrations which overestimate expected concentrations.

iii. The uncertainty relating to the validity of modelled Highway 3 emissions and its impact to modelled predictions.

Response:

As noted above, modelling of sources composed of moving point sources (*i.e.,* Highway 3, the rail road, and proposed haul road) is challenging for dispersion models, as these mobile source types are modelled as stationary sources with the same emission rates. The uncertainty comes in two forms:

- the fundamentals of modelling moving sources as fixed sources. Cowherd (2009) considers this to over-estimate predicted concentrations by a factor of 2 (up to a factor of 5 in some situations); and
- determining the setback distance from the source (*i.e.,* road or railway) where predictions are valid, as there are higher uncertainties adjacent to the source and better agreement among models at distances beyond 100 m to 300 m from these sources (Staniaszek *et al.* 2019).

With the potential road alignment changes identified in the Alberta Transportation (2013) in Highway 3 and the addition of the rail spur, these uncertainties are exacerbated especially for predictions in the immediate vicinity of these infrastructure changes. Farther from the changes, the model predictions, from the setback perspective, are expected to be more accurate.

The approach to managing NO_2 emission and concentration uncertainties will be to implement the adaptive management portion of the Project's air quality mitigation and monitoring plan (please see response to JRP IR-1.3). Monitoring will provide an indication of the contribution of current community, Highway 3 and rail sources. Measurements will be compared to Baseline predictions in Table 1.6-1. Based on the measurements, the need for mitigation beyond the current planned will be assessed.

Additional possible Project NO_2 mitigation options were provided in a previous Project information request (ECCC-R2-6, Addendum 8: CEAR #89). These mitigations are presented again here for ease of reference:

- For one-hour predictions associated with mining operations, the main emission source is identified as blasting. All blasting was assumed to occur during one hour of the day. Two mitigation options exist for this activity:
  - a commitment to investigate an alternative blasting agent (ammonium nitrate and fuel oil [ANFO]) formulation that reduces NOx emissions during blasting; and
  - spread blasting occurrences over two or more hours of the day, or over more days of the week, thus reducing blasting emissions by a factor of 2 or more in any one hour.
- Benga is prepared, when contracting with CP for clean coal shipping, to request CP to use the lowest emitting locomotives in its fleet to service Benga operations;
- Annual average predictions (at the mine permit boundary) associated with mining operations are driven by exhaust emissions rather than blasting. During operations, Benga will use Tier 4 engines in heavy duty mine equipment. These engines use the newest available technology;
- During the life of the Project, the mine fleet will be regularly maintained and as necessary upgraded. Equipment will likely become newer and more efficient than assumed in emission estimation as the mine progresses. Exhaust emissions from the

U.S. EPA Tier 4 (2015) standards were used in Project emission estimates and it is likely that technology will exceed these standards with time;

- The mine will have an integrated dispatch system to provide overall control of individual trucks and allocating sequencing and routing to minimize delays and unnecessary idling and fuel wastage. The fleet will also be managed to minimize fuel consumption by minimizing haul road length and gradient.

References

Alberta Environmental Protection. 2013. Air Quality Model Guideline. https://open.alberta.ca/publications/9781460105993.

Alberta Transportation. Highway 3 Planning. 2013. http://www.transportation.alberta.ca/projects/assets/Area_8_South/Hwy%203%20CNP/Open%20House%203%20Exhibits/Open%20House%203%20Exhibits%20Original%203X%20Route.pdf.

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Reed, W.R. and E.C. Westman, 2005. A model for predicting the dispersion of dust from a haul truck. International Journal of Surface Mining, Reclamation and Environment Volume 19, 2005 - Issue 1.

1.7 Information Request 1.7

Agreement to Establish a Joint Review Panel for the Grassy Mountain Coal Project Between The Minister of the Environment, Canada and The Alberta Energy Regulator, Alberta (Including Terms of Reference). (CEAR #80).

Eighth Addendum to the Environmental Impact Assessment. (CEAR #89).

In the Joint Review Panel's Terms of Reference (CEAR #80), the federal Minister of the Environment requires that all "incremental air pollutant and greenhouse gas emissions that are directly attributable to the Project, including rail to the west coast of B.C. and marine emissions within Canadian territorial waters" be taken into account.

In Section 3.2.3 of Appendix A-1 in Addendum 8 (CEAR #89), Benga provided GHG emission estimates for rail and marine transport outside of the RSA. In addition, Benga estimated the effect of the Project relating to smog forming emissions in the Lower Fraser Valley. However, in order to understand the potential incremental air pollutant effect of the Project resulting from transportation of coal to the B.C. coast and marine emissions out to territorial waters, the emissions from both Project-related rail and marine transport must be quantified.

a) For rail transport to port that can be attributed to the transport of product from the Project:

  i. Provide an estimate of the incremental emissions associated with the project for NO_x, fine particulate, fugitive dust emissions, and GHG emissions;

Response:

Emissions from rail transport:

Table 1.7-1 lists the annual emissions associated with rail transportation based on the current locomotives and also based on future implementation of Tier IV locomotives. The table indicates that the rail emissions associated with the Project will decrease by more than 80% for NOx and fine particulates after Tier IV implementation.

Table 1.7-1 Annual Rail Emissions to Transport Coal Product from the Project to the West Coast of B.C

Locomotive Engine	Power Rating (hp)	Tier	Engine Units	Load Factor (LF)	Emission Factors (g/hp-hr) *			Annual Emission (t/yr)		
					NO_x	CO	$PM_{2.5}$	NO_x	CO	$PM_{2.5}$
Current Locomotive										
GE AC4400 Locomotive	4,400	1	4	0.21	7.40	2.20	0.220	264	78	7.8
Future Implementation										
Tier IV Locomotive	4,400	4	4	0.21	1.30	1.50	0.030	46	53	1.1

* Source: https://www.dieselnet.com/standards/us/loco.php

Based on the Transport Canada Grade Crossing Inventory, the current traffic on the CP line Crowsnest subdivision is 8 trains per day and the total number of trains operating in Metro Vancouver is 124 per day. The Project would increase rail traffic and rail emissions about 18% in the Crowsnest subdivision and about 1.2% in the Metro Vancouver area.

GHG emissions from rail transport:

The CN emission calculator determined the annual GHG emissions to be 63.5 kt CO_2e. GHG emissions associated with rail transport over the life of the project would be about 1.53 Mt.

Fugitive dust emissions from rail transport:

In the response to JRP IR-1.1, Benga noted the expected loss of windblown dust during transport is 0.09%. If 3.8 Mt of coal are transported each year, a total of 3420 t is expected to be blown from the open cars, spread over 1,100 km of travel.

If all the railcar fugitive dust settled within 50 m of the rail line, the annual deposition would be about 310 kg/ha, equivalent to 26 mg/100 cm^2 per 30 days. This estimate can be compared to the 30-day Alberta deposition guideline of 53 mg/100 cm^2 in residential and recreation areas and 158 mg/100 cm^2 in industrial and commercial areas (https://open.alberta.ca/dataset/0d2ad470-117e-410f-ba4f-aa352cb02d4d/resource/4ddd8097-6787-43f3-bb4a-908e20f5e8f1/download/aaqo-summary-jan2019.pdf).

ii. Provide the methodology used to determine emissions from locomotives and fugitive dust associated with the rail cars, including:

- locomotive emission factors
- number of locomotives per train
- distance travelled
- assumed age distribution of locomotive fleet (and any assumptions of Tier IV locomotive transition); and
- assumptions used to estimate the fugitive coal dust lost from the open air rail cars and deposited along the rail route.

Response:

Our assumption on locomotive age (Tier 1 assumed) was based on Table 1.7-2 provided as part of the response to ECCC IR 14, February 2018. According to Market Realist (2016) the average working life of CP's fleet in the U.S. is 25 years. Assuming a similar age in Canada, all CP locomotives would reach Tier 4 standards by 2040. CP's EMD SD90MAC locomotives manufactured in the mid-1990s (Tier 0 to Tier 1 emissions compliance) are currently in storage and for sale, demonstrating a trend to the operation of lower emission units. Beyond this, no assumptions were made on the age distribution of the fleet.

Further assumptions used to calculate locomotive emissions were:

- locomotive emission factors are listed in Table 1.7-2;
- all trains on the current CP line meet Tier 1 standards and consist of 4 locomotives, which are similar to the 4400 h.p. GE AC4400 locomotive;
- the rail travel distance of 1,100 km from the Project to the west coast of B.C.;
- average train speed is 60 km/h, about 18.3 hours per trip for transport of coal product to the west; and

- approximately 263 trips per year will be required to service the Riversdale facility. Based on return trips, this will result in an increase of 1.44 trips of train per day operating through the Crowsnest subdivision west of Blairmore.

Table 1.7-2 Line-Haul Locomotive Emission Standards, g/bhp·hr

Tier	MY	Date	HC	CO	NOx	PM
Tier 0[a]	1973-1992[c]	2010[d]	1.00	5.0	8.0	0.22
Tier 1[a]	1993[c]-2004	2010[d]	0.55	2.2	7.4	0.22
Tier 2[a]	2005-2011	2010[d]	0.30	1.5	5.5	0.10[e]
Tier 3[b]	2012-2014	2012	0.30	1.5	5.5	0.10
Tier 4	2015 or later	2015	0.14[f]	1.5	1.3[f]	0.03

a - Tier 0-2 line-haul locomotives must also meet switch standards of the same tier.
b - Tier 3 line-haul locomotives must also meet Tier 2 switch standards.
c - 1993-2001 locomotive that were not equipped with an intake air coolant system are subject to Tier 0 rather than Tier 1 standards.
d - As early as 2008 if approved engine upgrade kits become available.
e - 0.20 g/bhp-hr until January 1, 2013 (with some exceptions).
f - Manufacturers may elect to meet a combined NOx+HC standard of 1.4 g/bhp-hr.

Source: https://www.dieselnet.com/standards/us/loco.php

As noted in Section 3.2.3.3 of Appendix A-1 in Addendum 8 (CEAR #89), GHG emissions associated with the rail transport of coal product from the Project to the west coast of B.C was calculated based on the use of the CN Rail calculator (https://www.cn.ca/repository/popups/ghg/Carbon-Calculator-Emission-Factors), and the following assumptions:

- an emission factor of 15.2 g CO_2e per tonne-km, based on the CN rail emission calculator;
- 3.8 Mt of clean coal shipped in Year 19; and
- the rail travel distance of 1,100 km from the Project to the west coast of B.C.

As noted in the response to JRP IR-1.4, the method used to estimate loss of material during open-air rail shipping to port consisted of wind-tunnel and vibration testing of coal at 9% moisture sieved through #6 mesh (3.4 mm) to provide consistent, small particle size to simulate worst-case conditions following in-house developed procedures to evaluate crust quality for various formulations. To simulate the stress exerted on the coal crust during rail transport, samples were placed on the vibrator for a period ranging from one to ten minutes in order to drive the crust to failure. The testing procedure for these vibrated samples was as follows:

1. Prepare, treat coal and dry railcar samples.
2. Use DCT at various concentrations; 1X, 2X and 3X the original concentration.
3. Dry samples under solar lamps overnight.
4. Vibrate on the vibrator in the holder closest to the motor for 1, 5 or 10 minutes.
5. Take pictures and measurements and treat Control with APS.
6. Dry samples under solar lamps overnight.
7. Repeat pictures and measurements as needed.
8. High Velocity Wind Tunnel Testing for each sample was conducted to provide simulated performance in the field.

iii. Identify if railcar optimization and locomotive power-to-freight optimizations were considered in the emission estimates; and

Response:

Unless included in the calculations of the CN Rail Calculator (https://www.cn.ca/repository/popups/ghg/Carbon-Calculator-Emission-Factors), railcar optimization and locomotive power-to-freight optimizations were not considered in the emission estimates.

iv. Rationalize how improvements due to locomotive Tier IV implementation will offset rail emissions associated with the Project.

Response:

The effect of Tier 4 engine technology on locomotive emissions is shown in Table 1.7-1. With Tier 4 technology, and compared to the assumption of Tier 1 technology, emissions are expected to be reduced by factors of 1.5 for CO to 7.1 for $PM_{2.5}$.

b) Provide an estimate of the incremental emissions associated with the Project for NO_x and SO_2 emissions, as well as GHG emissions, from marine transport within Canadian territorial waters that can be attributed to the transport of product from the Project.

Response:

Summing engine emissions as provided in JRP IR-1.7 c) (below), SO_2 emissions per trip are 0.03 t and NO_2 emissions are 1.0 t. At an annual clean coal production rate of 3.8 Mt and using 200,000 dwt vessels, 19 trips are needed, leading to annual emissions from shipping in national waters of 0.57 t of SO_2 and 19 t of NO_2.

To put these emissions in context, consider the following:

- In 2015, 3100 ocean going vessels used Vancouver harbour (Port of Vancouver 2017). Benga would contribute an additional 19 vessels, an increase of 0.6%.
- The 2015 Port of Vancouver emission inventory covers approximately 25% of the distance from the port to international waters.
- Port SO_2 emissions in 2015 were 268 t. Assuming 25% of Benga vessel emissions fell within the inventory area, Benga's contribution to additional SO_2 would be about 1.2%.
- Port NO_2 emissions in 2015 were 13,000 t of which about 9000 t were due to marine vessels. Applying the 25% factor, Benga's contribution to additional NO_2 would be about 0.9% of total port emissions or 1.3% of marine vessel emissions.

Similarly, annual GHG shipping emissions are expected to be about 1.85 kt CO_2e. Over the life of the project, lifetime emissions based on these assumptions would be about 44.4 kt CO_2e.

c) Include details of the assumptions and methodology used to determine these emissions.

Response:

NO_x and SO_2 emissions from marine transport:

Emission factors were based on CARB (2011). The emission factors for engines during transit, maneuvering and hoteling depend on the type of fuel used (CARB, 2011). Beginning in 2020, marine distillate must have no more than 0.5% sulphur; while in emission control areas in Canada, the limit is 0.1% sulphur.

Table 1.7-3 Engine Emission Factors for Marine Distillate (0.1% sulphur) (g/kW-hr)

Engines	NOx	SO_2
Aux Engines (medium speed)	13.9	0.40
Main Engines (medium speed)	13.2	0.40

Other assumptions included:

- Capesize vessel capacity 200,000 dead weight tons with main engine power rating of 14,000 kW and a power ratio of 0.22 for auxiliary engines (3200 kW);
- Total distance in national waters of 180 km of which 150 km (80 nautical miles) is run at 13 knots average speed on main engines (6.2 hours) and 30 km at 7 knots average speed under aux engines (2.3 hours); and
- Load factors of 83% for main engines in transit and 45% for aux engines during maneuvering.

The emission equation is:

Emission = emission factor x operating hours x average power x %load.

The estimated emissions are given in Table 1.7-4.

Table 1.7-4 Emissions per trip in national waters

	Engine	Emission Factor (g/kW-h)	Hours	Avg Power (kW)	%Load	Emission (t) per trip
SO_2	Main	0.4	6.2	14000	0.83	0.0288
	Aux	0.4	2.3	3200	0.45	0.0013
NO_2	Main	13.2	6.2	14000	0.83	0.950
	Aux	13.9	2.3	3200	0.45	0.046

GHG emissions from marine transport:

As noted in Section 3.2.3.3 of Appendix A-1 in Addendum 8 (CEAR #89), the estimation of GHG marine shipping emissions of GHG assumed the following:

- 3.8 Mt of clean coal shipped in Year 19;
- capesize class of dry bulk cargo vessel, with an emission intensity of 2.7 g CO_2e per km-cargo tonne (Psaraftis and Kontovas 2009); and
- a travel distance of 180 km from the Port of Vancouver to international waters.

Table 1.7-5 GHG emissions per trip

	Engine	Emission Factor (g/kW-h)	Hours	Avg Power	%Load	Emission (t) per trip
CH_4	Main	0.08	6.2	14000	0.83	0.005764
	Aux	0.09	2.3	3200	0.45	0.000298
CO_2	Main	645	6.2	14000	0.83	46.46838
	Aux	690	2.3	3200	0.45	2.28528

References

CARB (2011), "Emissions Estimation Methodology for Ocean-Going Vessels", California Air Resources Board, Planning and Technical Support Division, Appendix D.

Port of Vancouver. 2017. 2015 Port Emissions Inventory Report. https://www.portvancouver.com/wp-content/uploads/2017/12/2015PortEmissionsInventory.pdf

Psaraftis, H.N. and C. A. Kontovas. 2009. CO_2 Emission Statistics for the World Commercial Fleet. WMU Journal of Maritime Affairs.

1.8 Information Request 1.8

Grassy Mountain Coal Project - Updated Environmental Impact Assessment. Section C – Project Description. (CEAR #42).

Grassy Mountain Coal Project - Updated Environmental Impact Assessment. Consultant Report #1 – Air Quality. (CEAR #42).

Eighth Addendum to the Environmental Impact Assessment. (CEAR #89).

Section 4.3 of Consultant Report #1 (CEAR #42), indicates the main sources of direct GHGemissions for the Project are fugitive emissions of coal bed methane and diesel combustion in the mine fleet and haul vehicles. The report notes that other GHG emission sources will have a negligible contribution to the total GHG emissions for the Project. Year 19 of the Project is expected to produce the highest annual GHG emissions at 362 kt/year.

As per the Joint Review Panel's Terms of Reference (CEAR #80), the federal Minister of the Environment requires that all "incremental air pollutant and greenhouse gas emissions that are directly attributable to the Project, including rail to the west coast of B.C. and marine emissions within Canadian territorial waters" be taken into account.

The Environmental Impact Statement, Section C.7.9 presents basic information about GHG emissions sources, emission goals, and long-term GHG management options, however does not provide GHG emission estimates for each stage of the Project nor a detailed approach to GHG mitigation measures.

a) Provide a list of GHG emission sources and associated emission estimates for each stage of the Project's life.

Response:

The information for this question comes from the following sources:

- EIS, 2016, including Consultant Report 1 Air Quality, Appendix A (Details of Emission Estimation) (CEAA Doc #42).
- Addendum 8, Appendix A-1, Cumulative Effects Assessment, Section 3.2.3.3.1 (CEAA Doc #89).

Operations Phase

Direct Project emissions for GHG come from the following sources:

- fugitive emissions of coal bed methane;
- diesel combustion in the mine fleet and haul vehicles on site, including tree clearing, soil movement, blasting, haul trucks, dumping, processing, and conveyor operations.
- diesel use in blasting during operations and construction (6% of overall use and included in mobile emissions); and
- transportation emissions during operations.

Fugitive methane emissions from surface coal mining (operations stage) were estimated using emission factors provided by the Intergovernmental Panel on Climate Change (IPCC 2006). The IPCC provides a range of emission factors that depend on the overburden depth of the mine. In the absence of overburden information, or country-specific emission factors, the IPCC considers it good practice to use the average emission factors of 1.2 m^3 CH_4 /t coal production for surface mining and 0.1 m^3 CH_4 /t coal production for post-mining (for an overall emission factor of 1.3 m^3 CH_4/t).

Using the IPCC recommended methane density of 0.67 x 10^{-6} kg/m^3; the resulting emission factor is calculated to be 870 t CH_4/ Mt of coal production. The global warming potential factors used in estimating GHG emissions are 1 for CO_2, 21 for CH_4, and 310 for N_2O emissions, based on a 100-year time horizon (U.S. EPA 2005). The estimated GHG emissions from fugitive methane are 70 kt CO_2e per year for Year 19 based on 3.8 Mt annual coal production. If a global warming potential of 25 is used for methane, the fugitive emission increases to 83 kt CO_2e per year.

GHG emissions from diesel-fuelled vehicles and equipment were based on the annual average fuel consumption and Environmental Canada (EC) (2011) emission factors. The amount of diesel fuel consumed in Year 19 was 63,675,000 L, based on engineering estimates provided by Benga. About 90% of the diesel fuel for the mine operations will be consumed by trucks and equipment with engines larger than 600 hp. Using these data and the GHG emission factors for diesel combustion in Table 1.8-1, the GHG emissions from diesel fueled vehicles in year 19 is 172 kt.

Environment Canada GHG emission factors used for combustion sources are summarized in Table 1.8-1.

Table 1.8-1 GHG Emission Factors for Diesel Combustion

Compound	Diesel Engines ≤ 600 hp[a] (kg/1000 l)	Diesel and Gasoline Engines > 600 hp[a] (kg/1000 l)
CH_4	0.068	0.14
N_2O	0.21	0.082
CO_2	2,663	2,663

[a] Environment Canada (2011)

The GHG emissions associated with electricity consumption are based on the electricity generation intensity for Alberta of 930 g CO_2e/kWh (EC 2015). Benga estimates the electricity consumption for Year 19 will be 129,145,600 kWh. Therefore, GHG emissions in Year 19 due to electricity consumption is calculated as 120 kt.

A summary of direct annual GHG emissions for the Project from both fugitive and combustion sources as well as electricity consumption is shown in Table 1.8-2.

Table 1.8-2 Project Total GHG Emissions in Year 19 and Over the Life of Project

Source	GHG Emissions in Year 19 (kt CO_2e)	Lifetime GHG Emissions (kt CO_2e)
Fugitive Methane	70	1,692
Diesel Combustion	172	4,139
Electricity Consumption	120	2,896
Total	**362**	**8,727**

The maximum equivalent CO_2 emissions from the Project were estimated to be 362 kt in Year 19. According to Environment Canada (2015), total national GHG emissions were 726 Mt in 2013 and Alberta's share was 36.8% or 267 Mt. Therefore, GHG emissions of the Project in Year 19 will be approximately 0.14% of 2013 Alberta GHG emissions and 0.05% of national emissions.

The total coal production over the life of the Project will be approximately 92.6 Mt. The total GHG emission over the life of the Project will be 8,727 kt, scaled from annual GHG emissions in Year 19, based on total coal production.

The rail emission estimation was based on the use of the CN Rail calculator (https://www.cn.ca/repository/popups/ghg/Carbon-Calculator-Emission-Factors). The assumptions that went into the calculation were:

- 3.8 Mt of clean coal shipped in Year 19;
- a rail travel distance of 1,100 km; and
- an emission factor of 15.2 g CO_2e per tonne-km, based on the CN rail emission calculator. This emission factor is similar to that used by the Railway Association of Canada (https://www.railcan.ca/rac-initiatives/locomotive-emissions-monitoring-program/) and it is therefore assumed CP Rail emissions will be similar.
- Based on these inputs, the CN emission calculator determined the annual emissions to be 63.5 kt CO_2e in Year 19 of the mine operation. Over the life of the project, lifetime emissions based on these assumptions would be about 1.53 Mt.

The estimation of marine shipping emissions assumed the following:

- 3.8 Mt of clean coal shipped in Year 19;
- capesize class of dry bulk cargo vessel, with an emission intensity of 2.7 g CO_2 per km-cargo tonne (Psaraftis and Kontovas 2009); and
- a travel distance of 180 km from the Port of Vancouver to international waters.

Based on these assumptions, annual shipping emissions are expected to be about 1.85 kt CO_2 in Year 19. Over the life of the project, lifetime emissions based on these assumptions would be about 44.4 kt.

Construction Phase

Emissions were determined by pro-rating the emission rates of GHGs from the Project mine and plant operation emissions using the ratio of material moved during the plant construction to the material moved during the peak year of the Project.

The construction of mine and plant includes earthworks for following:

- CHPP earthworks includes platforms from ROM pad to product stockpile in CHPP;
- Mine access road includes access road from Highway 3 to the start of the mine/overland conveyor access road; and
- Mine/overland conveyor access road.

Including waste rock mined during construction phase, the total material handled during the plant construction is about 2.9 million BCM, based on information provided by Benga in April 2016. It was further assumed that the density of the material moved was equal to that of gravel, which is approximately 2.1 t/m^3. The total mass of the material moved during the plant construction is estimated to be 6.0 Mt, which is approximately 5.5% of the total 109 Mt annual waste overburden volume in Year 19 (EIA 2016 (CEAR #42), CR#1, Appendix A, Table A3-1). Therefore, the plant construction emissions were scaled from operations emissions from mine and plant operation in Year 19. Operational emissions for the rail loadout and blasting in Year 19 were excluded from the estimation of construction emissions.

The total mass of material handled is likely conservative since the density of gravel is higher than that of soil (1.4 to 1.7 t/m^3). However, it is anticipated this additional mass should help cover any activities not accounted for in this estimate such as earthworks for culverts and ditches. These unaccounted activities are expected to be small compared to the total estimate listed below.

Haul roads are expected to undergo ongoing extension during operations. Haul road construction activities will take place concurrently with Project operations, and it is expected that operational vehicle activity indicators already include concurrent construction activities.

From these emission sources, the annual GHG emission during the plant construction is estimated to be 20 kt CO_2e, approximately 12% of the diesel combustion emissions of 172 kt CO_2e GHG emissions in Year 19.

Construction of the following activities may not be accounted for using the above approach: Highway 3 underpass, rail track, and conveyor. Therefore, Benga estimates the construction phase would be about 13% of the Year 19 or about 22 kt CO_2e.

Decommissioning and Reclamation Phase

Reclamation activities at the mine largely occur concurrently with mining activities and have already been accounted for in the GHG assessment for the peak operations of the Project. Other closure activities – deconstruction of plant other facilities, environmental monitoring, pumps to move water for some time – may not be included in these estimates but it is expected that GHG emissions of all sources especially the monitoring and pumping are insignificant compared to those already included in operations.

In summary, based on the assumptions above, GHG emissions are anticipated to be as listed in Table 1.8-3:

Table 1.8-3 Grassy Mountain Project GHG Emissions

Source	Highest Annual Emissions (kt CO_2e)	Lifetime Emissions (kt CO_2e)
Construction	-	22
Operations		
Mine	172	4,139
Rail Transport	64	1,530
Marine Shipping	1.9	44
Fugitive methane	70	1,692
Indirect (electricity)	120	2,896
Reclamation	Included in Operations	Included in Operations

b) Describe the methodology or approach that will be used to quantify all sources of GHGs, including a discussion of any quality control measures proposed to ensure credible emissions data is gathered.

Response:

Diesel Fuel on Site

Benga's largest source of emission is diesel combustion in its fleet which will be used in construction, operations and reclamation stages. Benga will track fuel use in the following ways and apply appropriate emissions factors to estimate emissions:

- Total fuel consumed by Benga will be tracked by fuel orders placed and fuel received *via* invoices from commodity supplier and/or delivery invoices.
- Fuel use of individual vehicles apportioned from total based on the respective distance travelled of each vehicle.
- Fuel consumed by blasting will be tracked by quantity of ANFO purchased and received *via* invoices.

Benga will require that contractors also provide estimates of fuel use for Benga activities. The requirement for tracking fuel consumption on the Project site by contractors will be a requirement in all Requests for Proposals.

Rail Transport

Benga expects to contract rail transport to CP Rail. Benga has not established a contract with them and not at the level of detail to establish GHG tracking. Benga will investigate the following approaches:

- Use of the RAC GHG Calculator to estimate emissions.
- Require tracking of fuel used in the transport from the loadout to the port in Vancouver on dedicated trains (or prorated on the basis of tonnage for mixed trains) and apply appropriate emission factors to estimate emissions.

Marine Transport

Shipping contracts are not yet established. Benga plans to require the following:

- Documented fuel use if the vessel is contracted to Benga coal.
- Estimated fuel use based on tonnage if transport is shared or if the ship is contracted by others.
- Information on the vessel make, model, class, age to provide an independent fuel use or emission estimate.

Fugitive Methane

Benga does not plan to measure fugitive methane emissions from exposed seams or piles. Benga will continue to use IPCC emission factors based on production.

Electricity Use

Benga will track electricity through its purchase invoices and on-site metered use and use grid average factors to estimate emissions. Should Benga contract for dedicated alternative electricity sources (*e.g.,* wind power), adjustments will be made to emission factors.

GHG Verification under CCIR

Finally, Benga expects to be included in the Alberta CCIR large emitters category and will undergo GHG emission verifications annually. Because of this process, it is expected the GHG monitoring and reporting processes will continually improve.

c) Provide a draft GHG management plan including mitigation measures intended to facilitate achievement of Benga's stated GHG emission goals.

Response:

The draft GHG Management Plan is provided in Appendix 1.8-1.

Reference

U.S. EPA. 2005. Metrics for Expressing Greenhouse Gas Emissions: Carbon Equivalents and Carbon Dioxide Equivalents. Office of Transportation and Air Quality EPA420-F-05-002. February 2005

NOISE

1.9 Information Request 1.9

Grassy Mountain Coal Project - Updated Environmental Impact Assessment. Consultant Report #2 – Noise. (CEAR #42).

Eighth Addendum to the Environmental Impact Assessment. (CEAR #89).

Section 3.2 of Consultant Report #2 (CEAR Doc#42), states that blasting noise was modeled for the Project using measured noise level data (dBA Leq and dBC maximum/impulsive) obtained from noise measurements conducted at other similar mines using similar or identical operating equipment.

The response to Health Canada's information request 14 (HC-R2-14, Addendum 8, CEAR #89) confirmed that noise modeling was conducted with a maximum of three blasts during the daytime and no blasting during the nighttime.

With respect to the rail loadout noise, Benga stated that the most significant components of the rail alignment and loadout that have noise sources are:

- the enclosed overland conveyor;
- the 300 tonnes surge bin that transfers coal with a vibratory feeder to the loadout bin (loadout); and
- the rail alignment with locomotives hauling train cars.

In Consultant Report #2, Benga indicated that all noise sources associated with the rail loadout were included in the Project-only assessment case, however no further details are provided. As a result, it is unclear whether all major impulsive sound sources associated with rail loadout were included in the noise impact assessment. For example, the noise impact assessment should include, but is not limited to, train car shunting noise and noise emitting from openings in the rail loadout building resulting from unloading coal to train cars.

Health Canada guidance entitled "Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise, January, 2017" states that the indoor sound pressure level should not exceed approximately 40 dBA LAmax more than 10-15 times per night. Additionally, the guidance states that when care facilities, including hospitals, nursing homes, daycare centres and homes for the elderly are identified as receptors that could be impacted by Project-related noise, it is good practice to consult with these facilities to determine whether certain sensitivities to sleep disturbance exist during the day. The guidance also states that if any such sensitivities are noted, that the threshold level for sleep disturbance specified in the World Health Organization's 1999 and 2009 guidance may be used to assess the severity of potential impacts on these receptors. Given that a hospital was identified in the local study area for the noise impact assessment, there is the potential for there to be sleep disturbance from both blasting and rail loadout impulsive noise.

a) Indicate whether there are any other sensitive receptors in the local study area, including nursing homes, daycare centres and homes for the elderly.

Response:

Table 1.9-1 outlines the identified sensitive receptors located within the Noise Impact Assessment (NIA) local study area, and distance (m) from the centre point of the proposed rail load out is provided in Figure 1.9-1.

Table 1.9-1 Identified Sensitive Receptors within the Noise Impact Assessment Local Study Area and Distance to the centre point of the proposed rail load out.

Receptor	Distance (m)
Alberta Health Services	1001
Crowsnest Consolidated High School	3124
Crowsnest Medical Clinic	3829
Crowsnest Pass Health Centre	650
Donnas A B C Day Care	1539
Horace Allen School	4683
Isabelle Sellon School	1241
Kids Kollege Nursery School	7780
Little Mountaineers Learning Centre	4315
Mountain Side Medical Clinic	1241
Stella's Tot Spot Daycare	3606
York Creek Seniors Lodge	944

As identified in Consultant Report CR#2, (EIA August 2016, CEAR # 42), the NIA Summary, which focussed on the rail alignment and loadout components, predicted noise levels of the rail alignment and loadout were added to the existing baseline/measured levels to determine the total project noise levels. A number of residential receptors were identified around Blairmore and Coleman, and were used in the predictive model to determine the relative impact of the Project on the local noise climate.

The locations of these receptors were provided in Figure 1, which is provided again for ease of reference as Figure 1.9-1. The identified sensitive receptors have been added to Figure 1.9-1 for comparison.

Results of the NIA Summary showed that the background noise monitoring results for night-time ranged from 47.1 – 51.6 dBA. The predicted background noise results generated by the model matched very well with the actual measurements. The night time modeling results for the

68 receptors (Figure 1.9-1) varied from 30.0 – 53.7 dBA, due primarily to their relative proximity to the area roadways (in particular Highway 3) and the rail line. Similarly, the modeled day-time noise levels ranged from 34.8 – 56.4 dBA.

The existing noise levels are expected to increase slightly at each receptor when the rail alignment and loadout are operational. For most of the receptors, the predicted night time noise increase is less than 2.0 dBA, which is considered a minimal increase. The maximum increase was predicted to be +4.1 dBA. For most of the receptors, the predicted day time noise increase is less than 2.0 dBA, which is considered a minimal increase. The maximum increase was predicted to be +2.5 dBA.

It is common and generally accepted practice to set +5.0 dBA as a maximum tolerable increase in noise levels for residential receptors. Any increase in noise levels above 5 dBA are expected to be noticed by the residential receptors. This guidance is provided by the Alberta Energy Regulator (AER) in Directive 038.

b) Provide a description of the impulsive sound sources associated with the rail loadout that were included in the noise impact assessment and indicate the predicted frequency of occurrence of each of the impulsive sound sources.

Response:

The operations for the rail loadout will include an empty train entering into the site, driving slowly and loading each rail car, and then leaving the site once all of the cars are loaded. There is no shunting planned for the site. The noise from the loading of coal into train cars has been included in the noise modeling, and it is not characterized as an impulsive noise source. Due to the design of the loadout as a continuous loop, no shunting or other similar impulsive noises are expected.

c) Provide impulsive noise level calculation results at the hospital, residential receptors, and any other sensitive receptors identified, and compare against Health Canada and World Health Organization guidance for sleep disturbance. Impulsive noise from train car shunting and the openings in the rail loadout building resulting from unloading coal to train cars should be included in the calculations.

Response:

As per the previous response, there are no impulsive noises anticipated associated with the Rail Loadout. Thus, the only impulsive noise is associated with the day-time blasting at the mine (*i.e.,* no night-time blasting). At the Hospital, the calculated exterior blasting impulsive noise level is 22.3 dBA during the day-time. This is below 40 dBA, which is the Health Canada and World Heath Organization guidance for sleep disturbance. When the attenuation associated with building infrastructure is taken into consideration, the interior noise levels will likely be below the expected 22.3 dBA and well below the 40 dBA guidance.

d) Provide a discussion of the results.

Response:

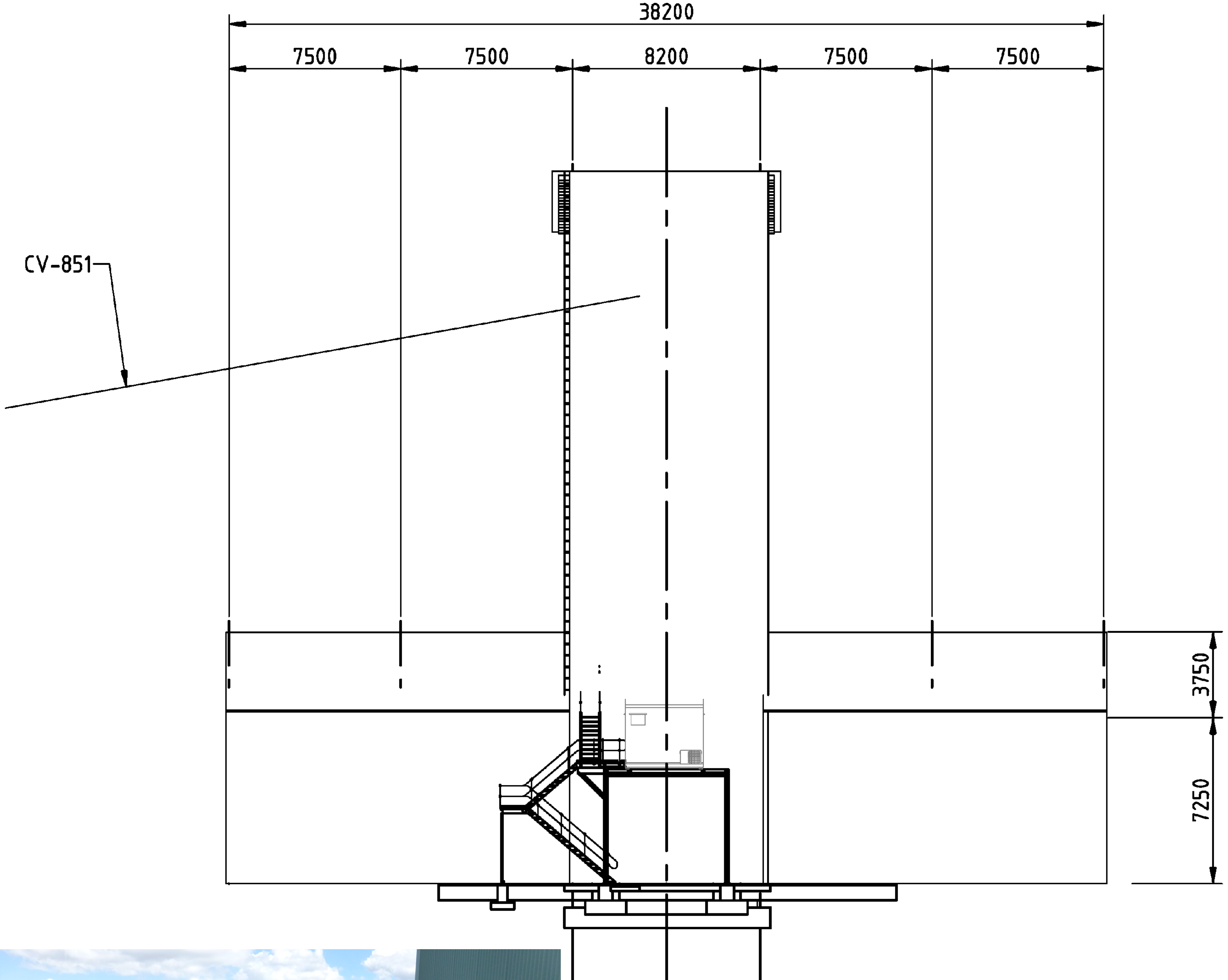
Please see response to JRP IR-1.9 c).

e) If the results indicate a potential for sleep disturbance at any of the receptor sites, describe the technically and economically feasible noise mitigation measures Benga proposes to implement.

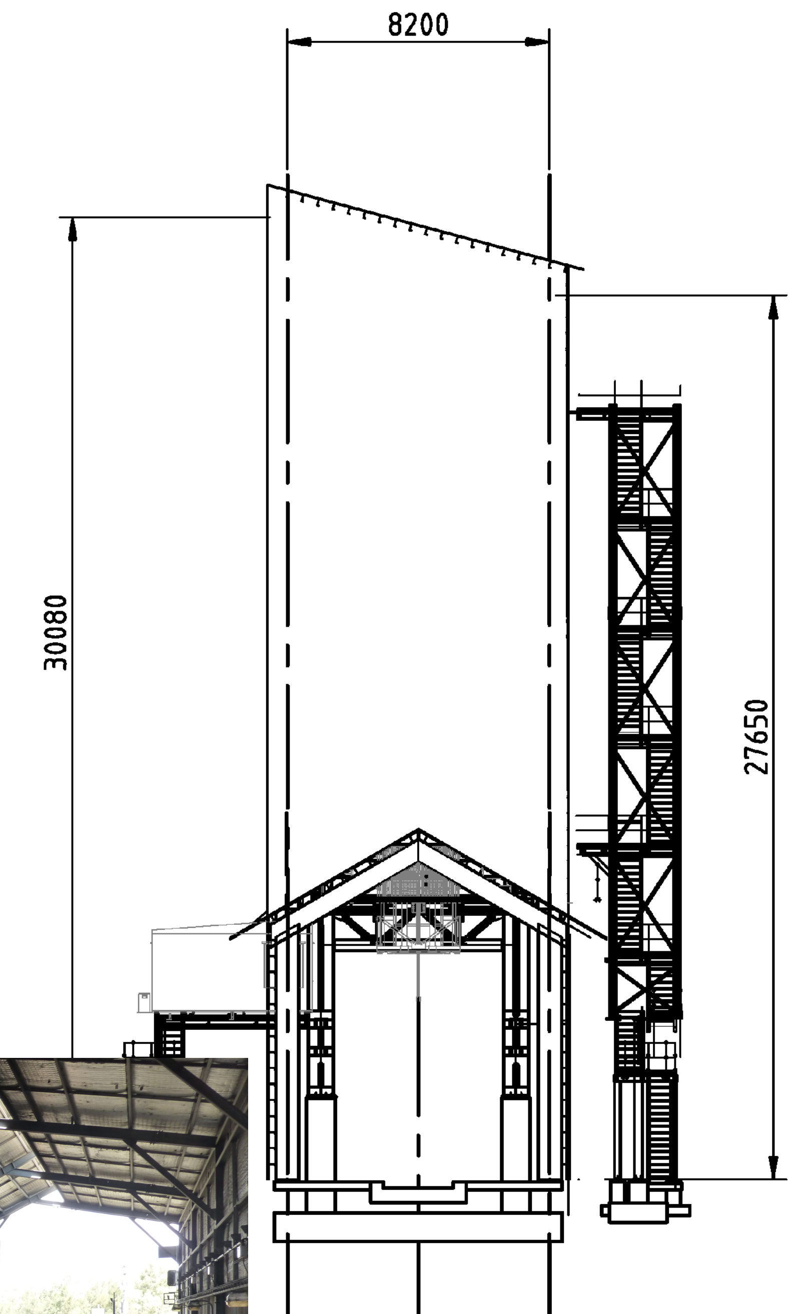
Response:

Based on the results of the NIA, potential for sleep disturbance is not expected as a result of the Project; thus, no further mitigation measures are required.

FIGURES



ELEVATION



RIGHT SIDE

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

MILLENNIUM EMS Solutions Ltd.

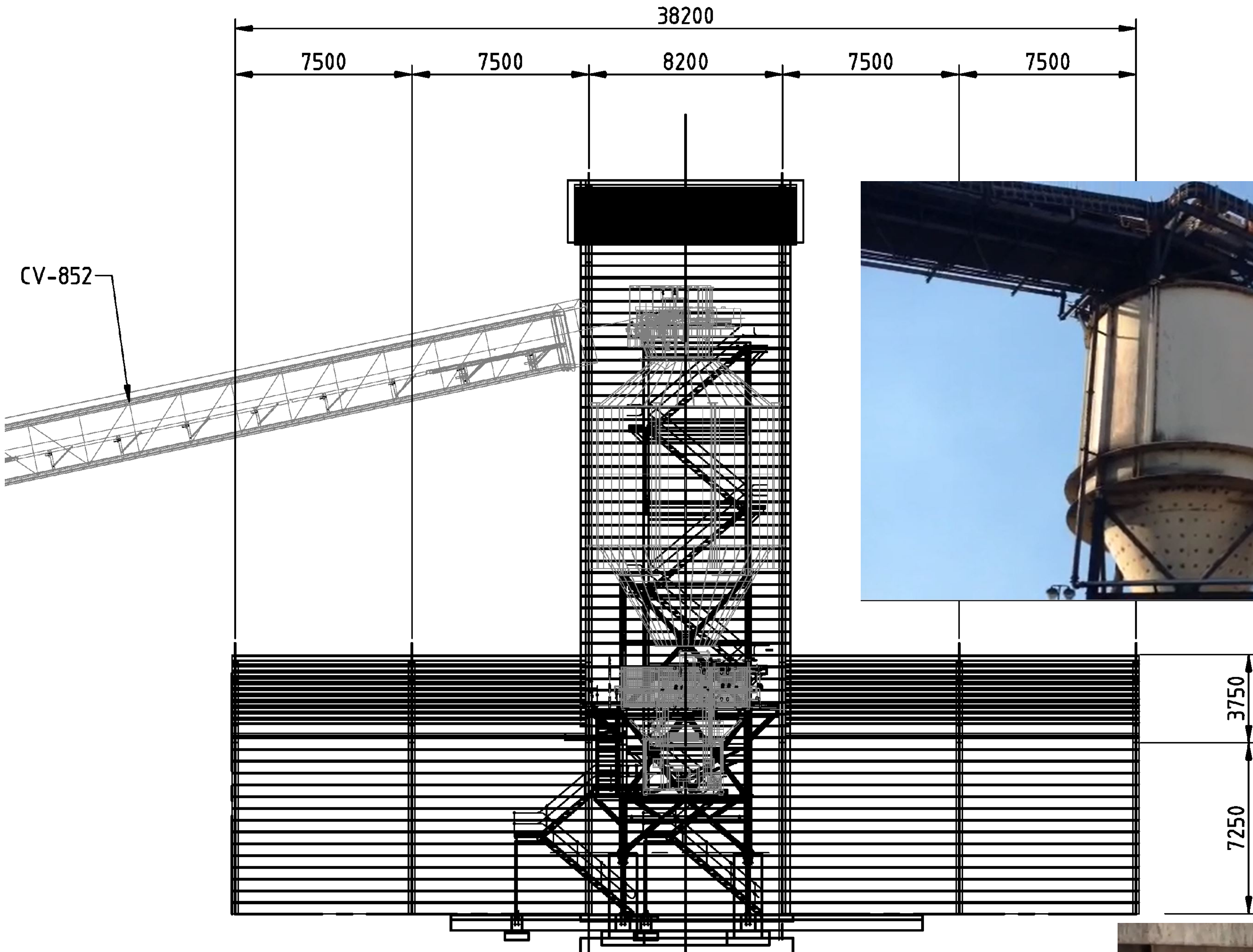
PROJECT: 14-00201
DRAWN BY: JLAMBERTS
CHECKED BY: KP
DATE: MAY 13, 2019

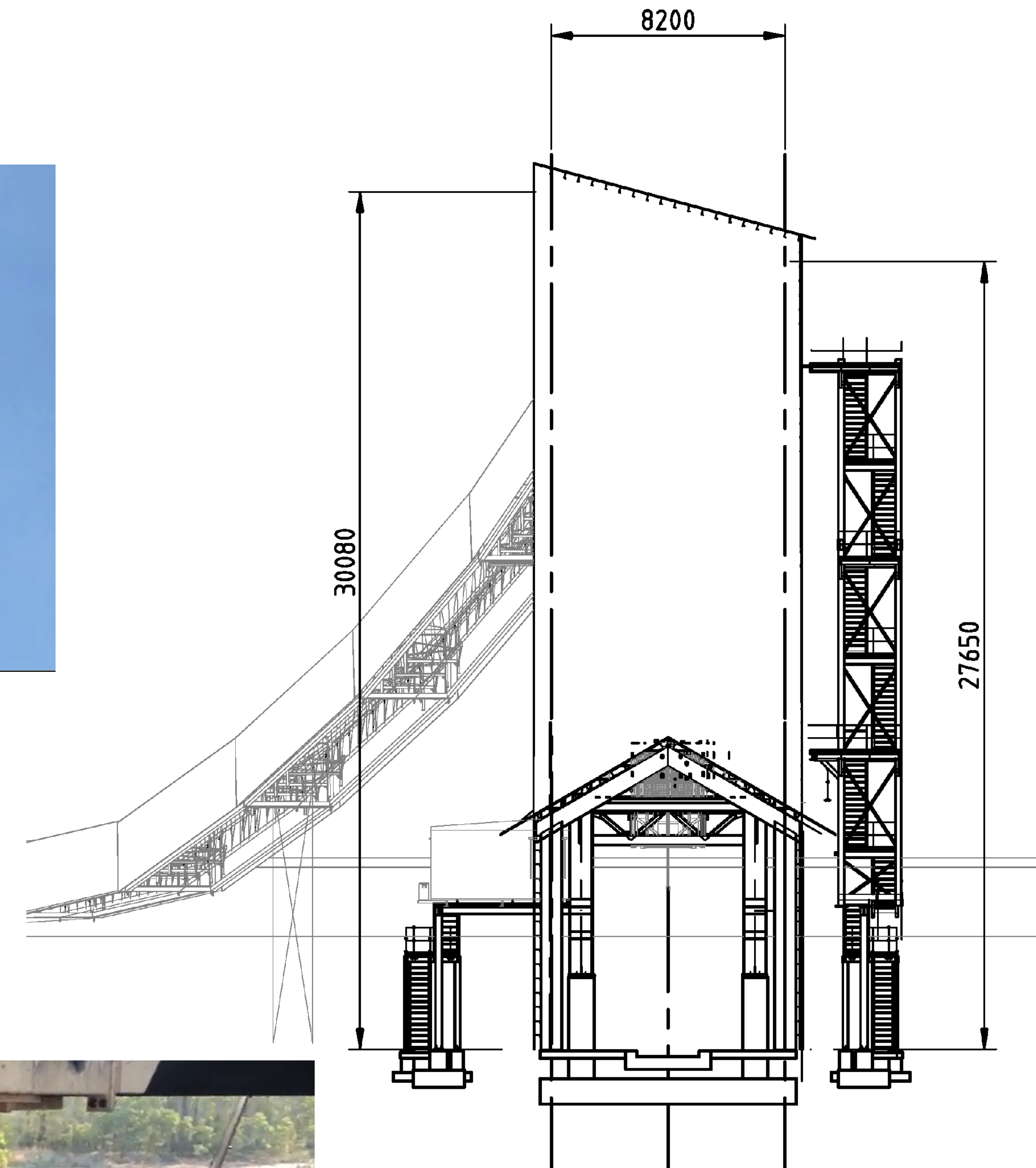
Train Load Out (TLO) Exterior Cladding Dimensions

Sedgan, 2015

0 5 10
Metres

FIGURE
1.2-1





This photo illustrates the minimal drop height of coal from the TLO to the rail car. The TLO in this photo does not have external cladding. **The Grassy Mountain TLO will be enclosed.**

RIGHT SIDE

Notes: Grassy Mountain TLO **will be fully enclosed**. The provided pictures are from an existing coal mine in Austraila that utilizes the TLO infrastructure that will be used for the Grassy TLO without the exterior cladding. This pictures are provided here to illustrate the process.
To clarify, the **Grassy Mountain TLO will have exterior cladding and an enclosed roof**.

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

TLO SUPPORTING INFRASTRUCTURE

Sedgan, 2015

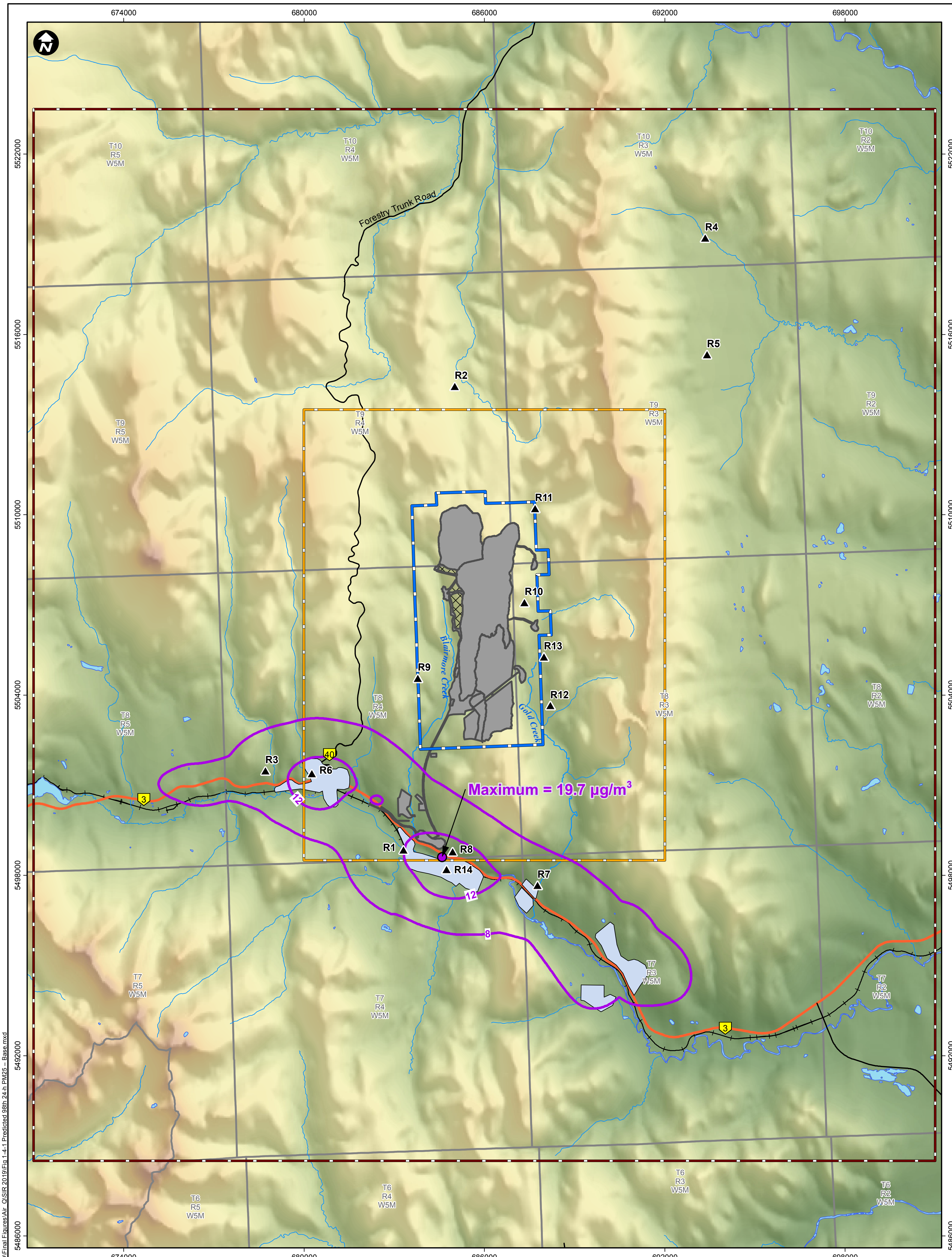
0 5 10
Metres

MILLENNIUM EMS Solutions Ltd.

PROJECT: 14-00201
DRAWN BY: JLAMBERTS
CHECKED BY: KP
DATE: MAY 13, 2019

FIGURE **1.2-2**

Document Path: K:\Active Projects 2014\AP 14-00201 to 14-00250\14-00201\MXD\Final Figures\Landuse\Resubmission\Information Request 3\Fig 1-2-3 TLO Supporting Infrastructure 14-00201.mxd



LEGEND

- ▲ Special Receptor
- Concentration Isopleth
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- Air Quality Local Study Area
- Air Quality Regional Study Area

Topography (masl)
High : 2800
Low : 1250

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

PREDICTED 98th PERCENTILE 24-HOUR $PM_{2.5}$ CONCENTRATION (µg/m³) – UPDATED BASELINE

MILLENNIUM EMS Solutions Ltd.

AltaLIS, 2019; Deswik, 2016; Golder, 2016; MEMS, 2019; Riversdale, 2019

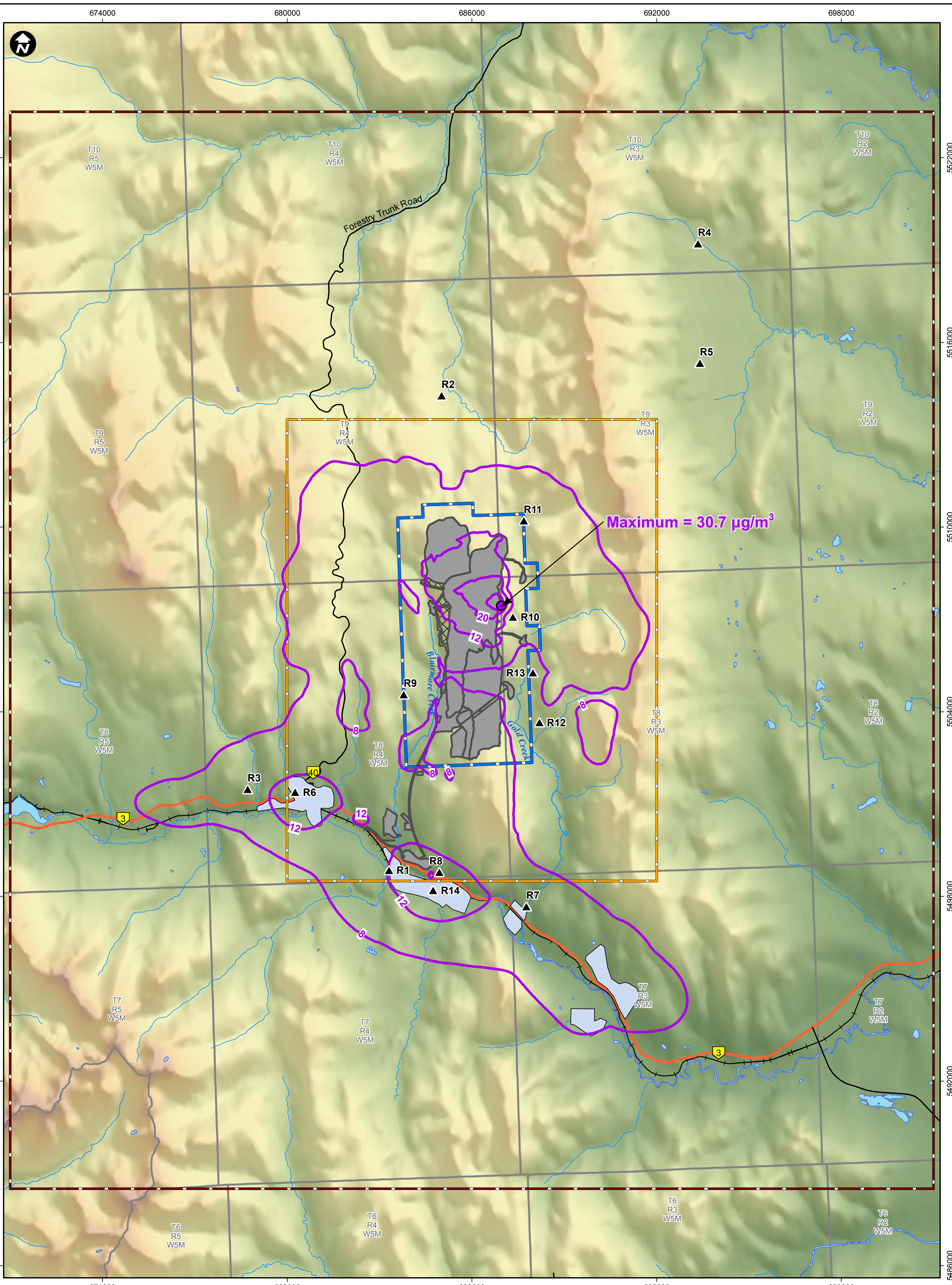
Coordinate System: NAD 1983 UTM Zone 11N

0 4 8
Kilometres

PROJECT: 14-00201-07
DRAWN BY: DCHEN
CHECKED BY: JS
DATE: APRIL 15, 2019

FIGURE
1.4-1

Document Path: K:\Active Projects 2014\AP 14-00201 to 14-00250\14-00201\MXD\Final Figures\Air_Q\SIR 2019\Fig 1.4-1 Predicted 98th 24-h PM25 – Base.mxd



LEGEND

- Special Receptor
- Concentration Isopleth
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- Air Quality Local Study Area
- Air Quality Regional Study Area

Topography (masl)
High : 2800
Low : 1250

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

PREDICTED 98th PERCENTILE 24-HOUR $PM_{2.5}$ CONCENTRATION (µg/m³) – UPDATED APPLICATION WITH 80% ROAD CONTROL EFFICIENCY

MILLENNIUM EMS Solutions Ltd.

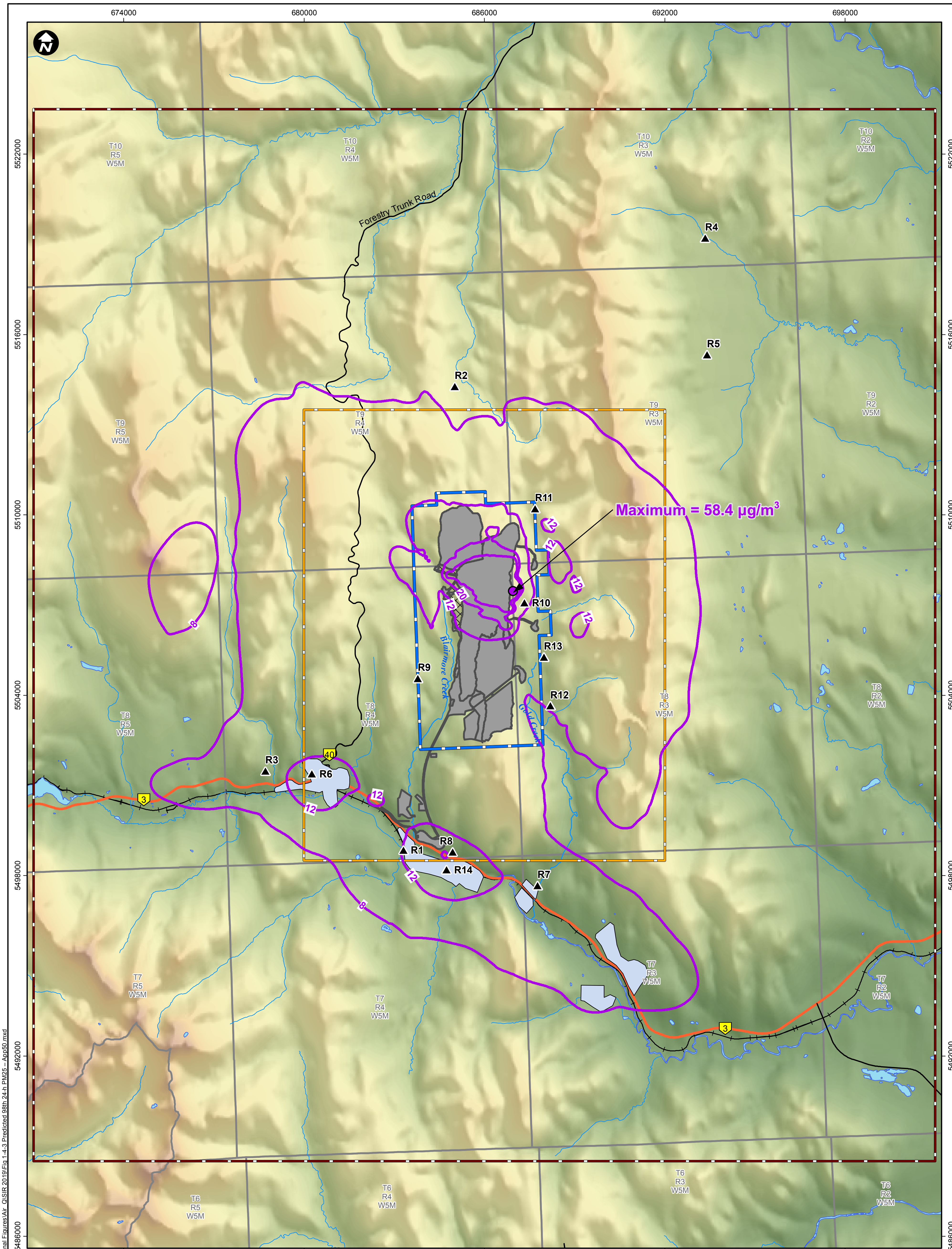
AltaLIS, 2019; Deswik, 2016; Golder, 2016; MEMS, 2019; Riversdale, 2019

Coordinate System: NAD 1983 UTM Zone 11N

0 4 8
Kilometres

PROJECT: 14-00201-07
DRAWN BY: DCHEN
CHECKED BY: JS
DATE: APRIL 15, 2019

FIGURE **1.4-2**



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LEGEND

- ▲ Special Receptor
- Concentration Isopleth
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- Air Quality Local Study Area
- Air Quality Regional Study Area

Topography (masl)
High : 2800
Low : 1250

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

PREDICTED 98th PERCENTILE 24-HOUR $PM_{2.5}$ CONCENTRATION (µg/m³) – UPDATED APPLICATION WITH 50% ROAD CONTROL EFFICIENCY

MILLENNIUM EMS Solutions Ltd.

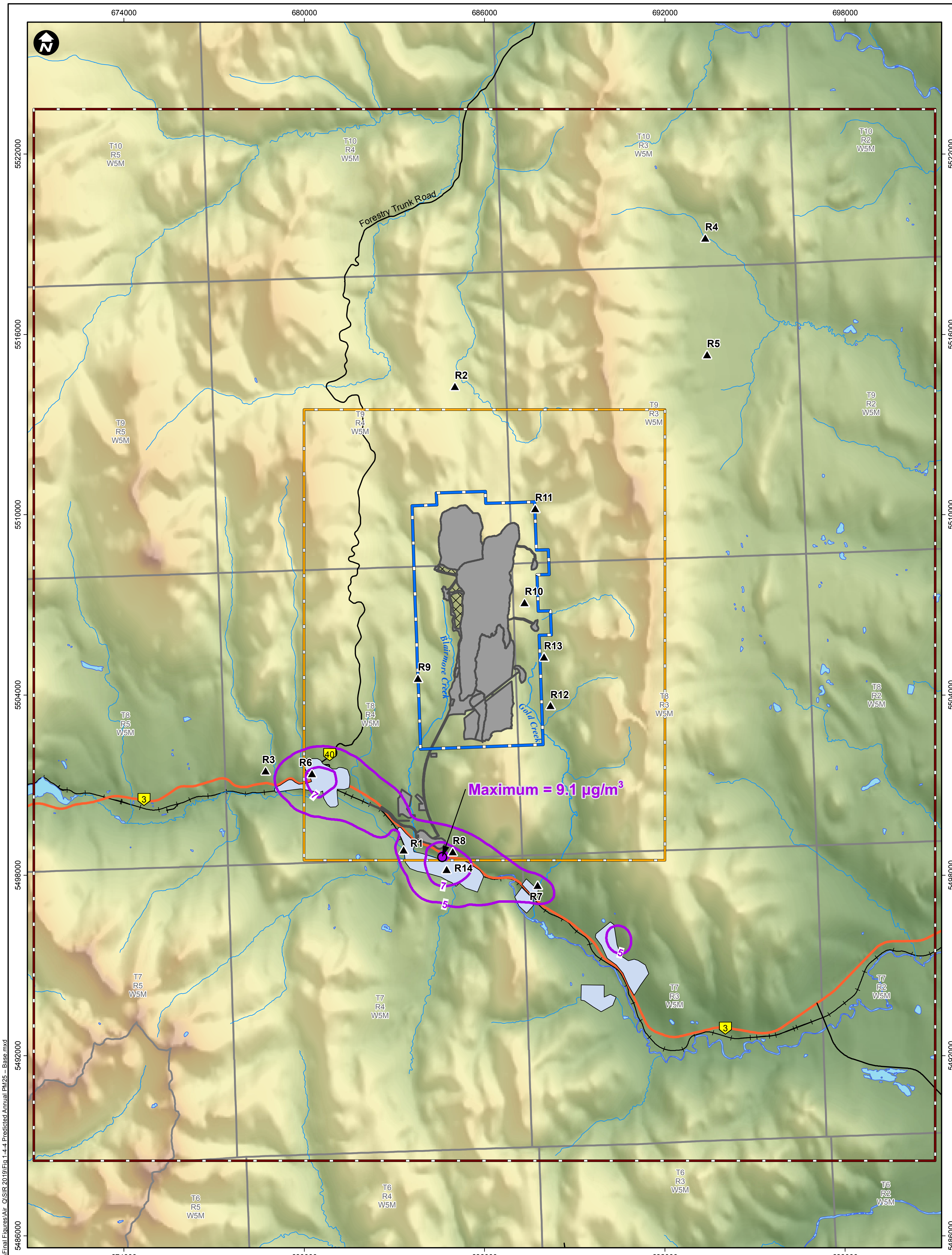
AltaLIS, 2019; Deswik, 2016; Golder, 2016; MEMS, 2019; Riversdale, 2019

Coordinate System: NAD 1983 UTM Zone 11N

0 4 8 Kilometres

PROJECT: 14-00201-07
DRAWN BY: DCHEN
CHECKED BY: JS
DATE: APRIL 15, 2019

FIGURE **1.4-3**



LEGEND

- ▲ Special Receptor
- Concentration Isopleth
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- Air Quality Local Study Area
- Air Quality Regional Study Area

Topography (masl)

High : 2800

Low : 1250

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

PREDICTED ANNUAL $PM_{2.5}$ CONCENTRATION ($\mu g/m^3$) – UPDATED BASELINE

MILLENNIUM EMS Solutions Ltd.

AltaLIS, 2019; Deswik, 2016; Golder, 2016; MEMS, 2019; Riversdale, 2019

Coordinate System: NAD 1983 UTM Zone 11N

0 4 8 Kilometres

PROJECT: 14-00201-07

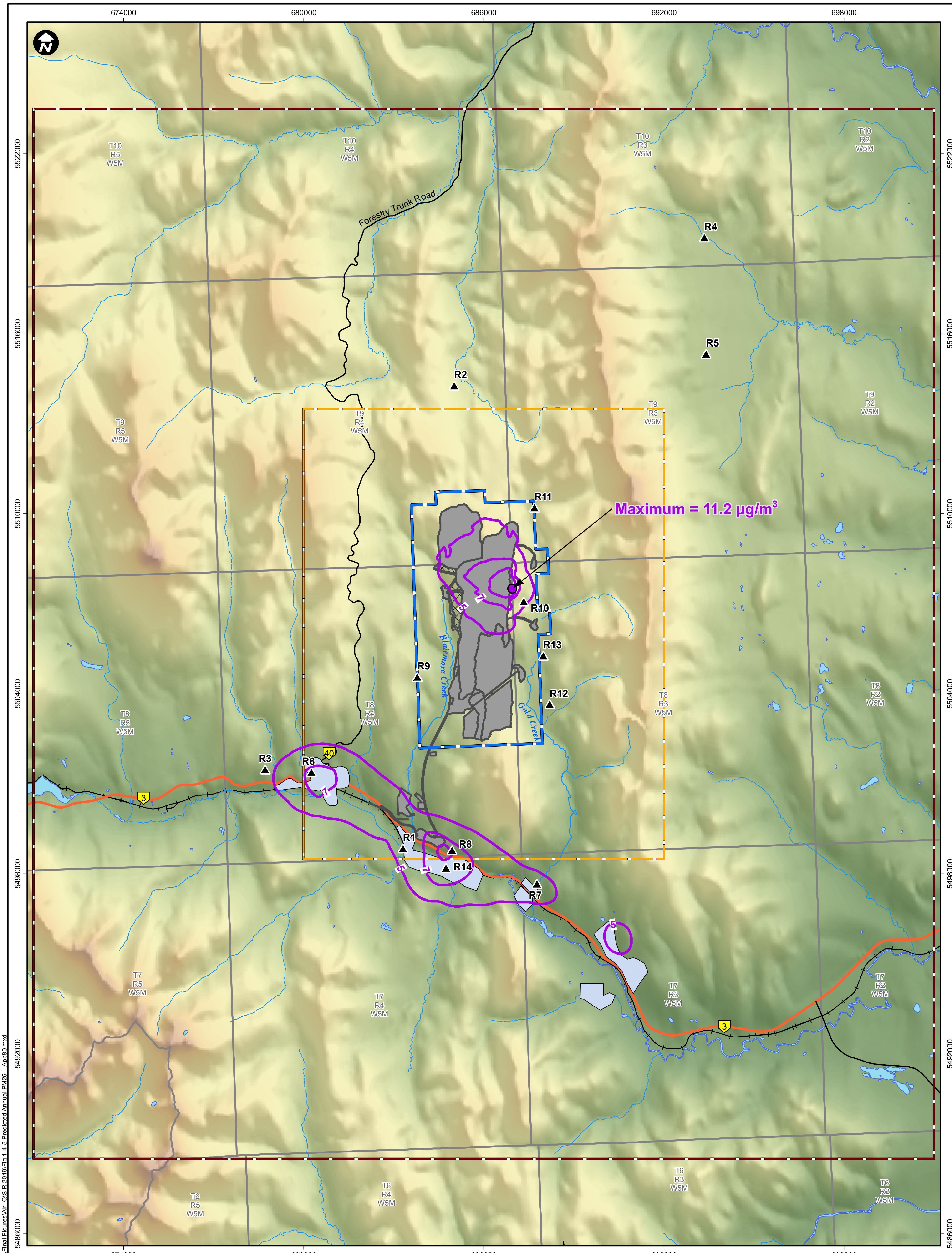
DRAWN BY: DCHEN

CHECKED BY: JS

DATE: APRIL 15, 2019

FIGURE

1.4-4



LEGEND

- Special Receptor
- Concentration Isopleth
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- Air Quality Local Study Area
- Air Quality Regional Study Area

Topography (masl)
High : 2800
Low : 1250

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

PREDICTED ANNUAL $PM_{2.5}$ CONCENTRATION (µg/m³) – UPDATED APPLICATION WITH 80% ROAD CONTROL EFFICIENCY

AltaLIS, 2019; Deswik, 2016; Golder, 2016; MEMS, 2019; Riversdale, 2019

Coordinate System: NAD 1983 UTM Zone 11N

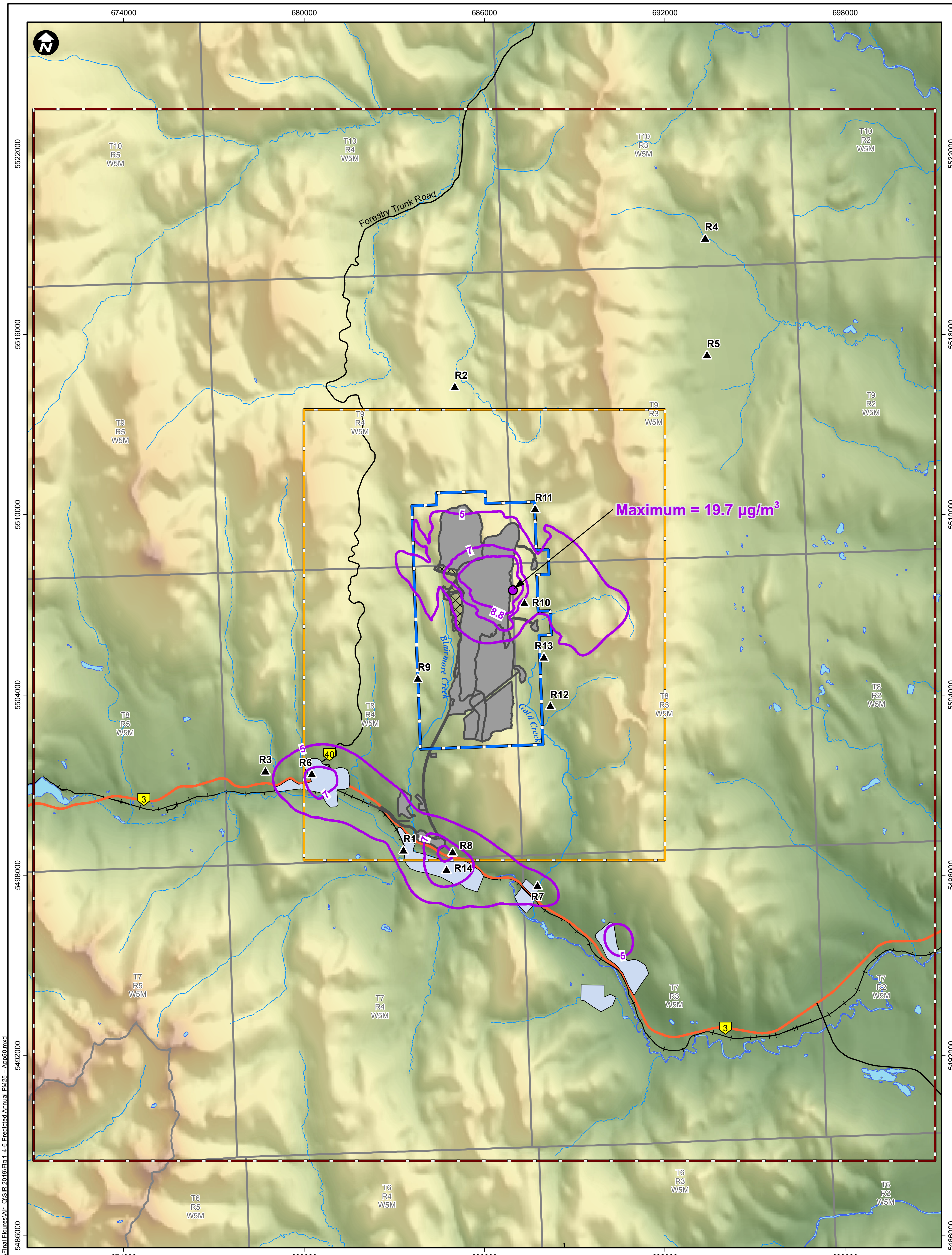
0 4 8
Kilometres

MILLENNIUM EMS Solutions Ltd.

PROJECT: 14-00201-07
DRAWN BY: DCHEN
CHECKED BY: JS
DATE: APRIL 15, 2019

FIGURE **1.4-5**

Document Path: K:\Active Projects 2014\AP 14-00201 to 14-00250\14-00201\MXD\Final Figures\Air_QISR 2019\Fig 1-4-5 Predicted Annual PM25 – App80.mxd



Document Path: K:\Active Projects 2014\AP 14-00201 to 14-00250\14-00201\MXD\Final Figures\Air_QSIR 2019\Fig 1.4-6 Predicted Annual PM25 – App50.mxd

LEGEND

- ▲ Special Receptor
- Concentration Isopleth
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- Air Quality Local Study Area
- Air Quality Regional Study Area

Topography (masl)
High : 2800
Low : 1250

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

PREDICTED ANNUAL $PM_{2.5}$ CONCENTRATION (µg/m³) – UPDATED APPLICATION WITH 50% ROAD CONTROL EFFICIENCY

MILLENNIUM EMS Solutions Ltd.

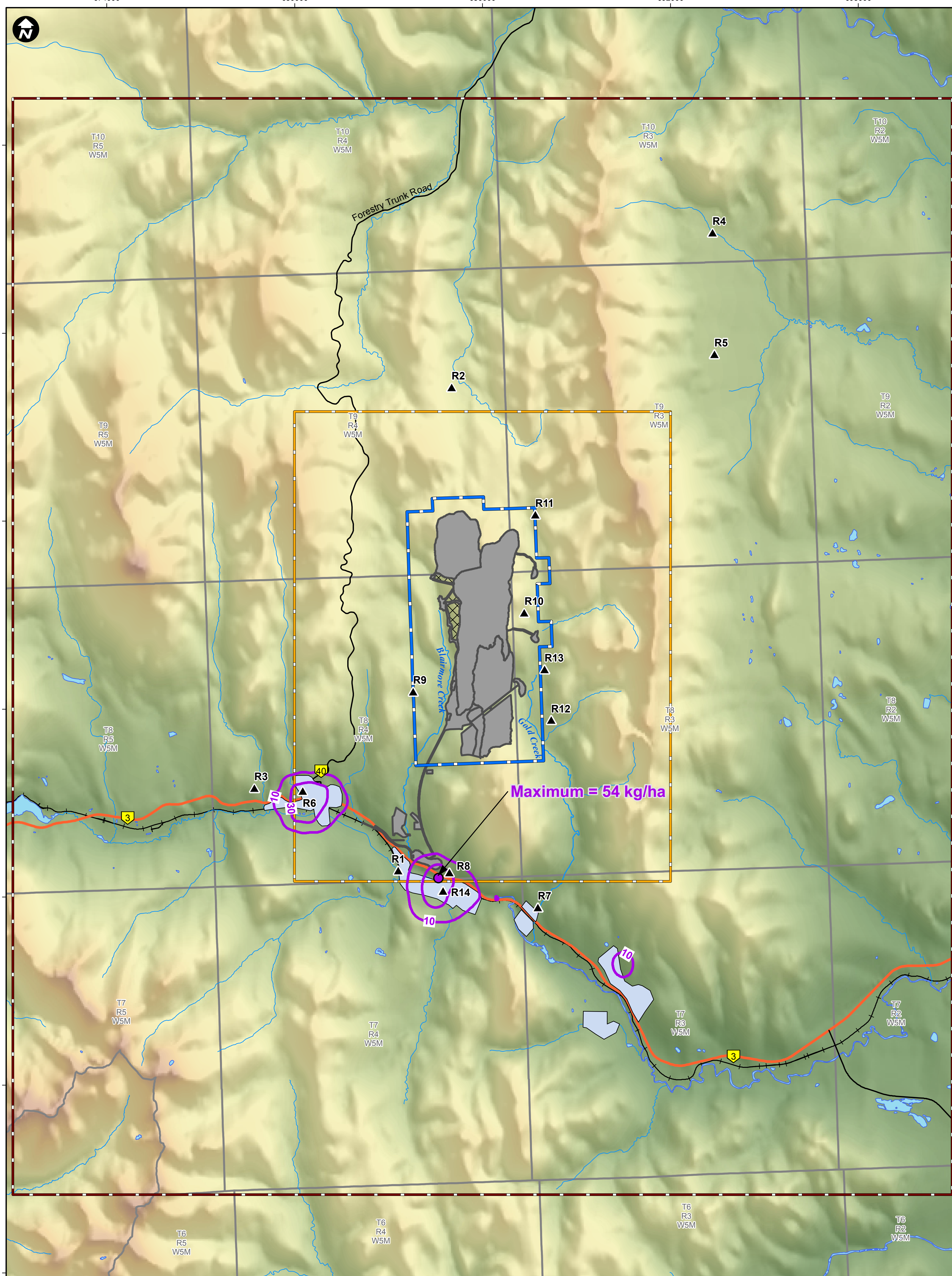
AltaLIS, 2019; Deswik, 2016; Golder, 2016; MEMS, 2019; Riversdale, 2019

Coordinate System: NAD 1983 UTM Zone 11N

0 4 8
Kilometres

PROJECT: 14-00201-07
DRAWN BY: DCHEN
CHECKED BY: JS
DATE: APRIL 15, 2019

FIGURE
1.4-6



Document Path: K:\Active Projects 2014\AP 14-00201 to 14-00250\14-00201\MXD\Final Figures\Air_QSIR 2019\Fig 1.4-7 Predicted 30-day TSP Deposition – Base.mxd

LEGEND

- ▲ Special Receptor
- Concentration Isopleth
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- Air Quality Local Study Area
- Air Quality Regional Study Area

Topography (masl)
High : 2800
Low : 1250

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

PREDICTED 30-DAY TSP DEPOSITION (kg/ha) – UPDATED BASELINE

MILLENNIUM EMS Solutions Ltd.

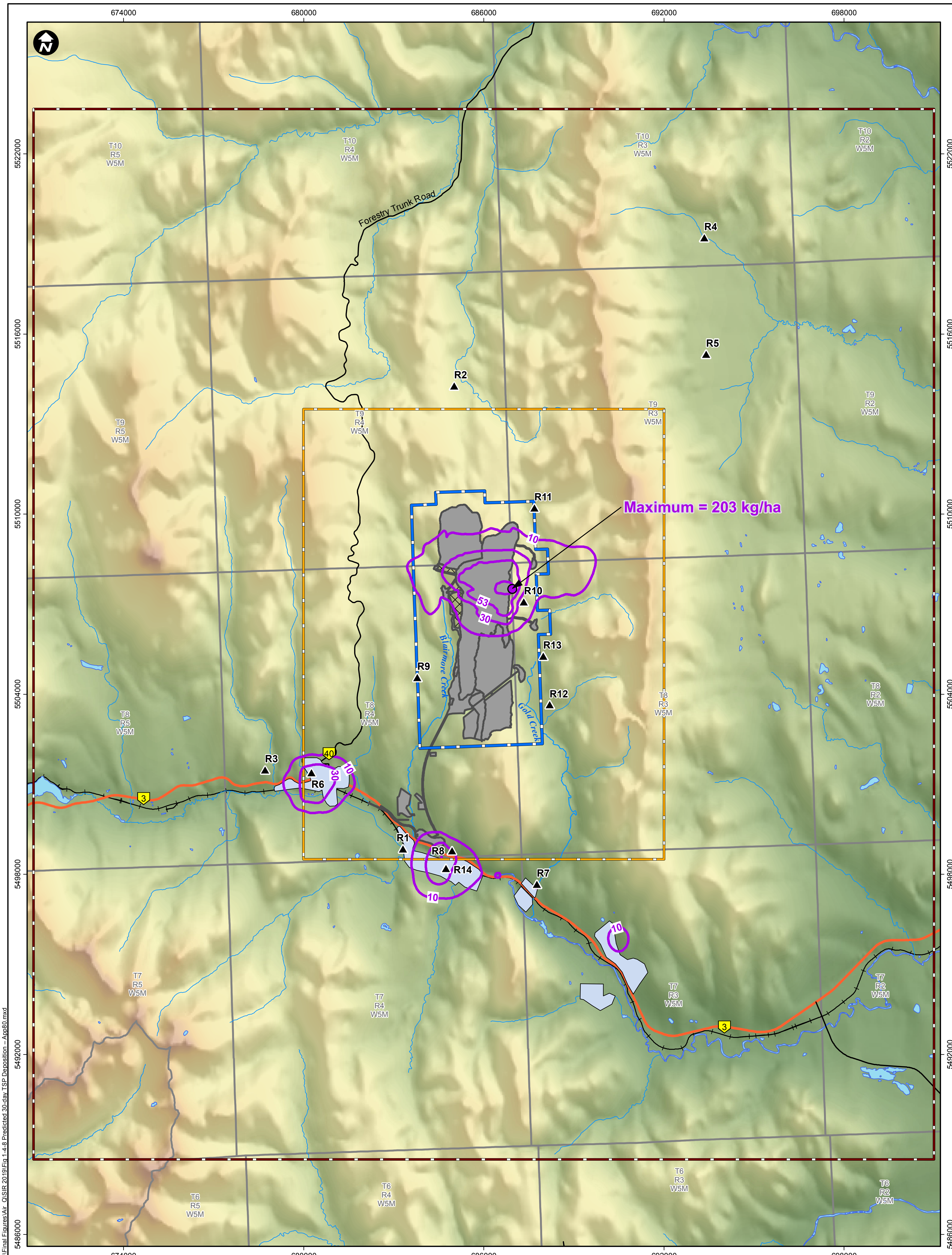
AltaLIS, 2019; Deswik, 2016; Golder, 2016; MEMS, 2019; Riversdale, 2019

Coordinate System: NAD 1983 UTM Zone 11N

0 4 8
Kilometres

PROJECT: 14-00201-07
DRAWN BY: DCHEN
CHECKED BY: JS
DATE: APRIL 15, 2019

FIGURE
1.4-7



LEGEND

- ▲ Special Receptor
- Concentration Isopleth
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- Air Quality Local Study Area
- Air Quality Regional Study Area

Topography (masl)
High : 2800
Low : 1250

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

PREDICTED 30-DAY TSP DEPOSITION (kg/ha) – UPDATED APPLICATION WITH 80% ROAD CONTROL EFFICIENCY

AltaLIS, 2019; Deswik, 2016; Golder, 2016; MEMS, 2019; Riversdale, 2019

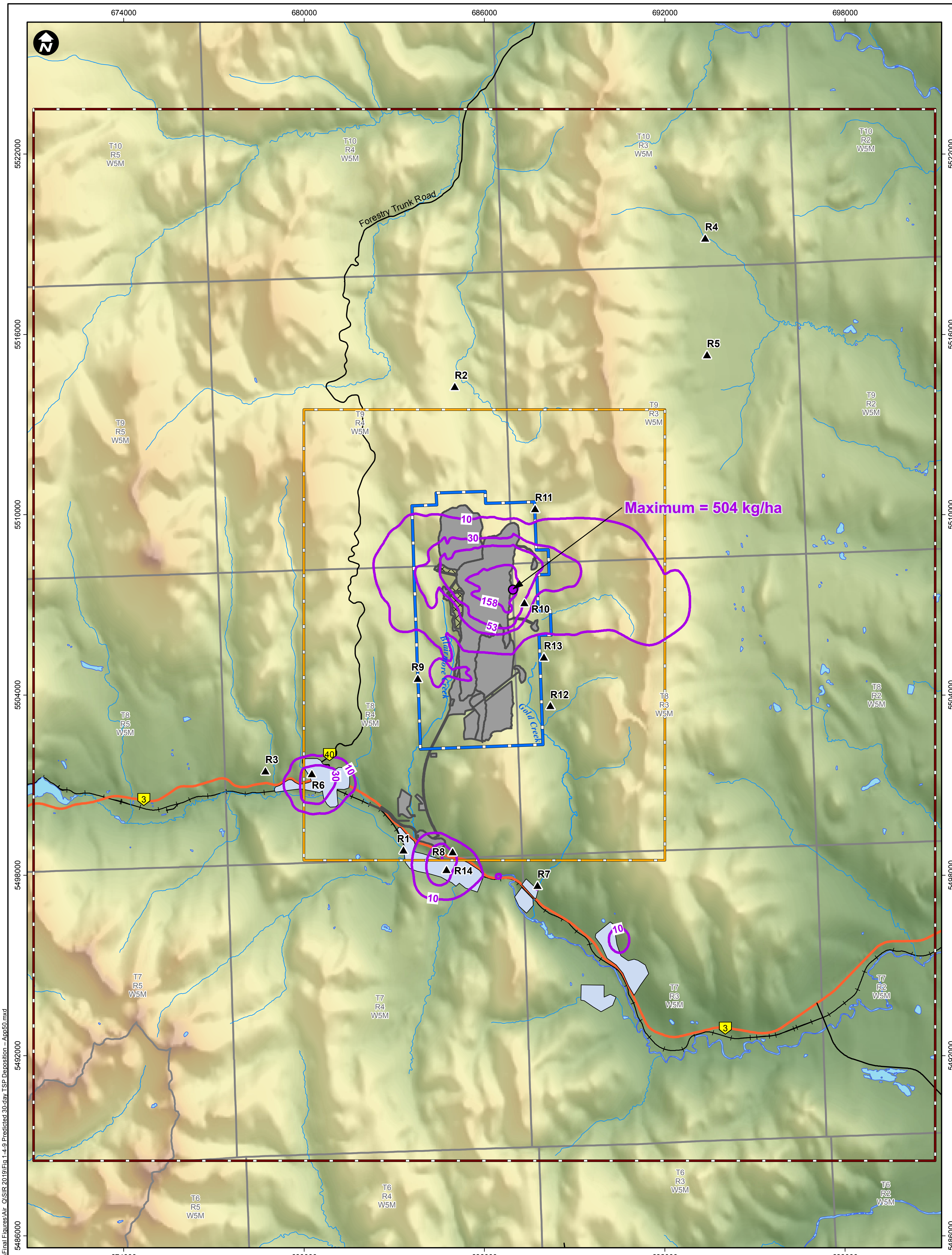
Coordinate System: NAD 1983 UTM Zone 11N

0 4 8
Kilometres

MILLENNIUM EMS Solutions Ltd.

PROJECT: 14-00201-07
DRAWN BY: DCHEN
CHECKED BY: JS
DATE: APRIL 15, 2019

FIGURE
1.4-8



Document Path: K:\Active Projects 2014\AP 14-00201 to 14-00250\14-00201\MXD\Final Figures\Air_Q\SIR 2019\Fig 1.4-9 Predicted 30-day TSP Deposition ~ App50.mxd

LEGEND

- ▲ Special Receptor
- Concentration Isopleth
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- Air Quality Local Study Area
- Air Quality Regional Study Area

Topography (masl)
High : 2800
Low : 1250

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

PREDICTED 30-DAY TSP DEPOSITION (kg/ha) – UPDATED APPLICATION WITH 50% ROAD CONTROL EFFICIENCY

AltaLIS, 2019; Deswik, 2016; Golder, 2016; MEMS, 2019; Riversdale, 2019

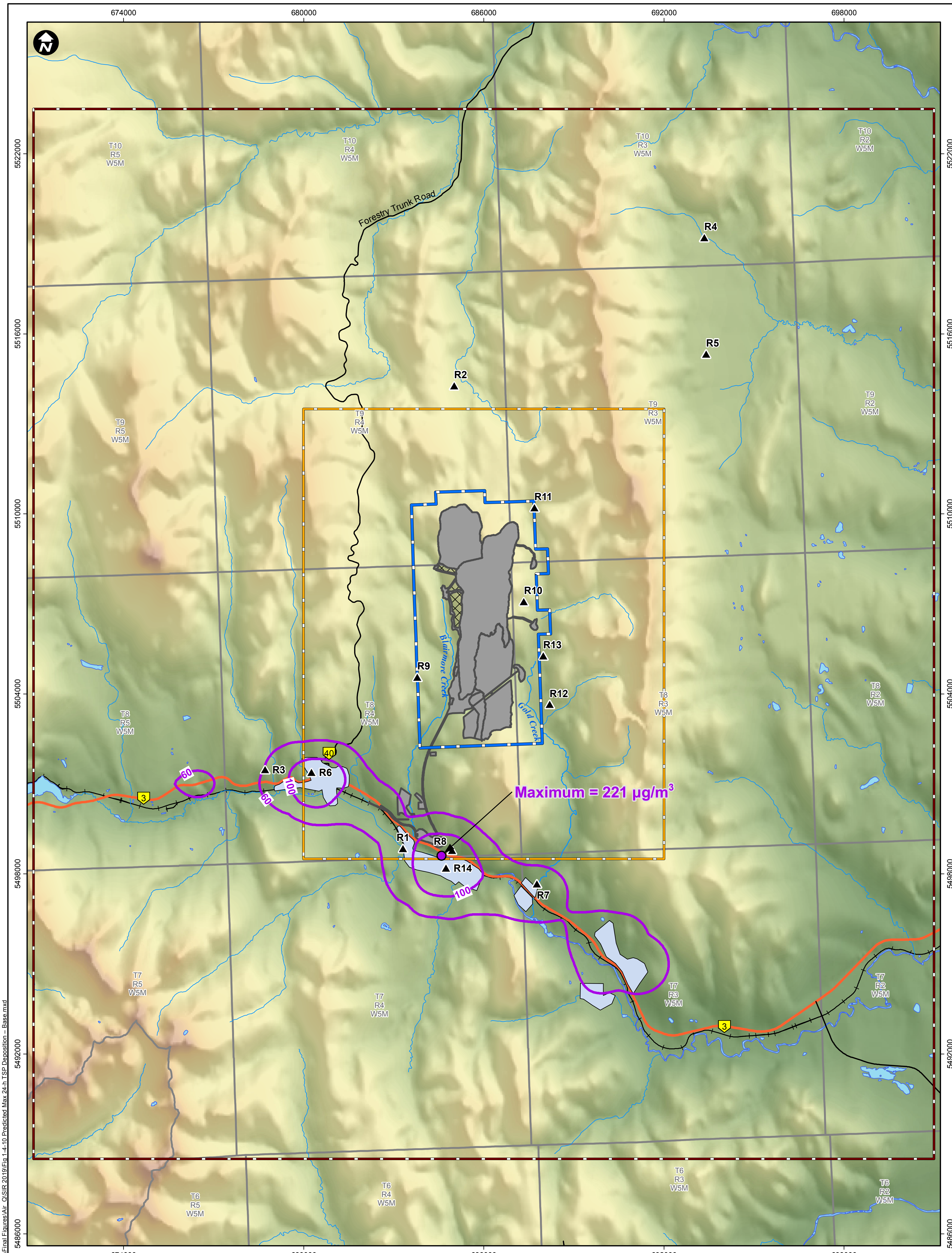
Coordinate System: NAD 1983 UTM Zone 11N

0 4 8
Kilometres

MILLENNIUM EMS Solutions Ltd.

PROJECT: 14-00201-07
DRAWN BY: DCHEN
CHECKED BY: JS
DATE: APRIL 15, 2019

FIGURE **1.4-9**



LEGEND

- Special Receptor
- Concentration Isopleth
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- Air Quality Local Study Area
- Air Quality Regional Study Area

Topography (masl)
High : 2800
Low : 1250

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

PREDICTED MAXIMUM 24-HOUR TSP CONCENTRATION (µg/m³) – UPDATED BASELINE

AltaLIS, 2019; Deswik, 2016; Golder, 2016; MEMS, 2019; Riversdale, 2019

Coordinate System: NAD 1983 UTM Zone 11N

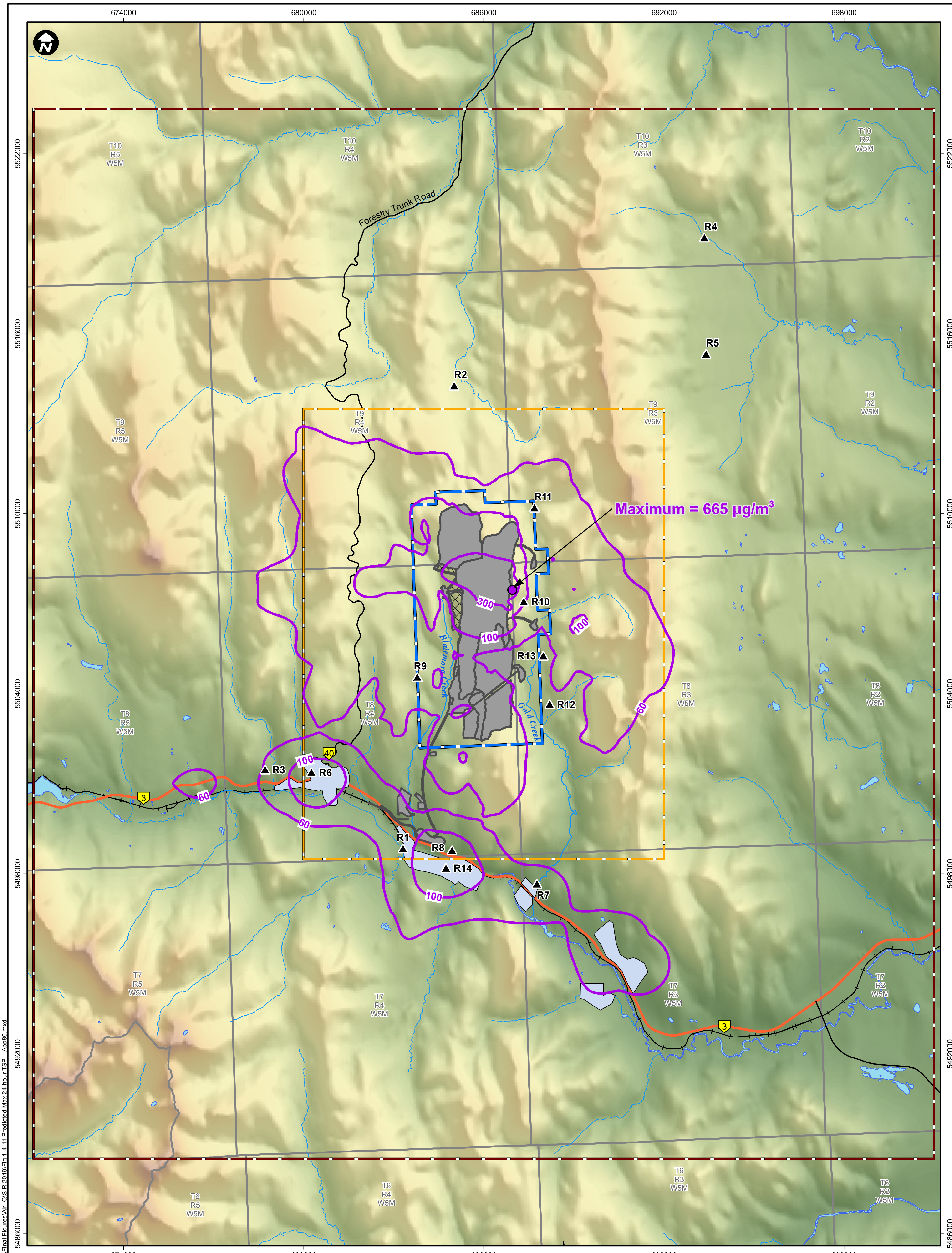
0 4 8
Kilometres

MILLENNIUM EMS Solutions Ltd.

PROJECT: 14-00201-07
DRAWN BY: DCHEN
CHECKED BY: JS
DATE: APRIL 16, 2019

FIGURE
1.4-10

Document Path: K:\Active Projects 2014\AP 14-00201 to 14-00250\14-00201\MXD\Final Figures\Air_QISIR 2019\Fig 1.4-10 Predicted Max 24-h TSP Deposition – Base.mxd



LEGEND

- ▲ Special Receptor
- Concentration Isopleth
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- Air Quality Local Study Area
- Air Quality Regional Study Area

Topography (masl)
High : 2800
Low : 1250

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

PREDICTED MAXIMUM 24-HOUR TSP CONCENTRATION (µg/m³) – UPDATED APPLICATION WITH 80% ROAD CONTROL EFFICIENCY

MILLENNIUM EMS Solutions Ltd.

AltaLIS, 2019; Deswik, 2016; Golder, 2016; MEMS, 2019; Riversdale, 2019

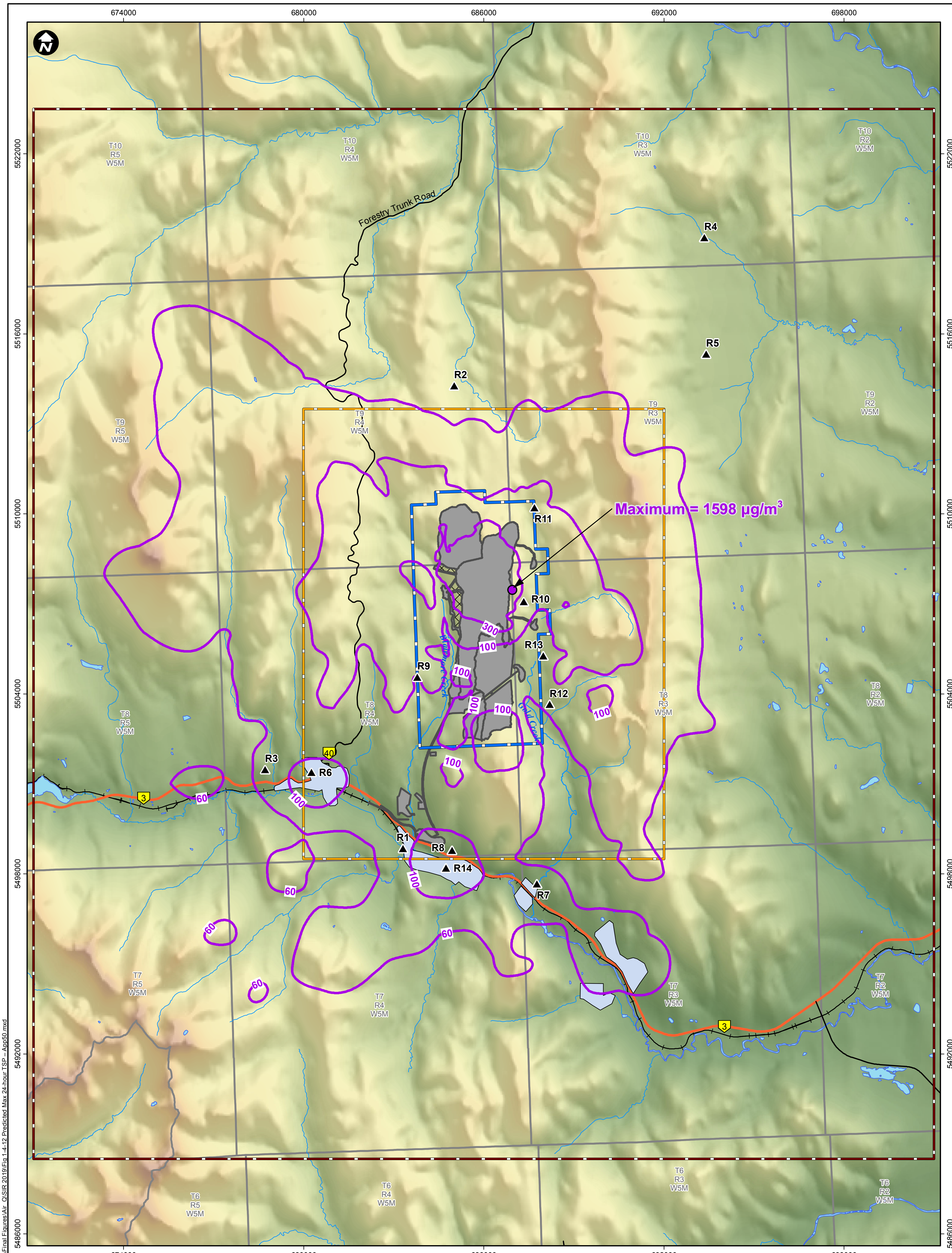
Coordinate System: NAD 1983 UTM Zone 11N

0 4 8
Kilometres

PROJECT: 14-00201-07
DRAWN BY: DCHEN
CHECKED BY: JS
DATE: APRIL 16, 2019

FIGURE
1.4-11

Document Path: K:\Active Projects 2014\AP 14-00201 to 14-00250\14-00201\MXD\Final Figures\Air_QISIR 2019\Fig 1-4-11 Predicted Max 24-hour TSP – App80.mxd



LEGEND

- ▲ Special Receptor
- Concentration Isopleth
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- Air Quality Local Study Area
- Air Quality Regional Study Area

Topography (masl)

High : 2800

Low : 1250

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

PREDICTED MAXIMUM 24-HOUR TSP CONCENTRATION (µg/m^3) – UPDATED APPLICATION WITH 50% ROAD CONTROL EFFICIENCY

AltaLIS, 2019; Deswik, 2016; Golder, 2016; MEMS, 2019; Riversdale, 2019

Coordinate System: NAD 1983 UTM Zone 11N

0 4 8

Kilometres

MILLENNIUM EMS Solutions Ltd.

PROJECT: 14-00201-07

DRAWN BY: DCHEN

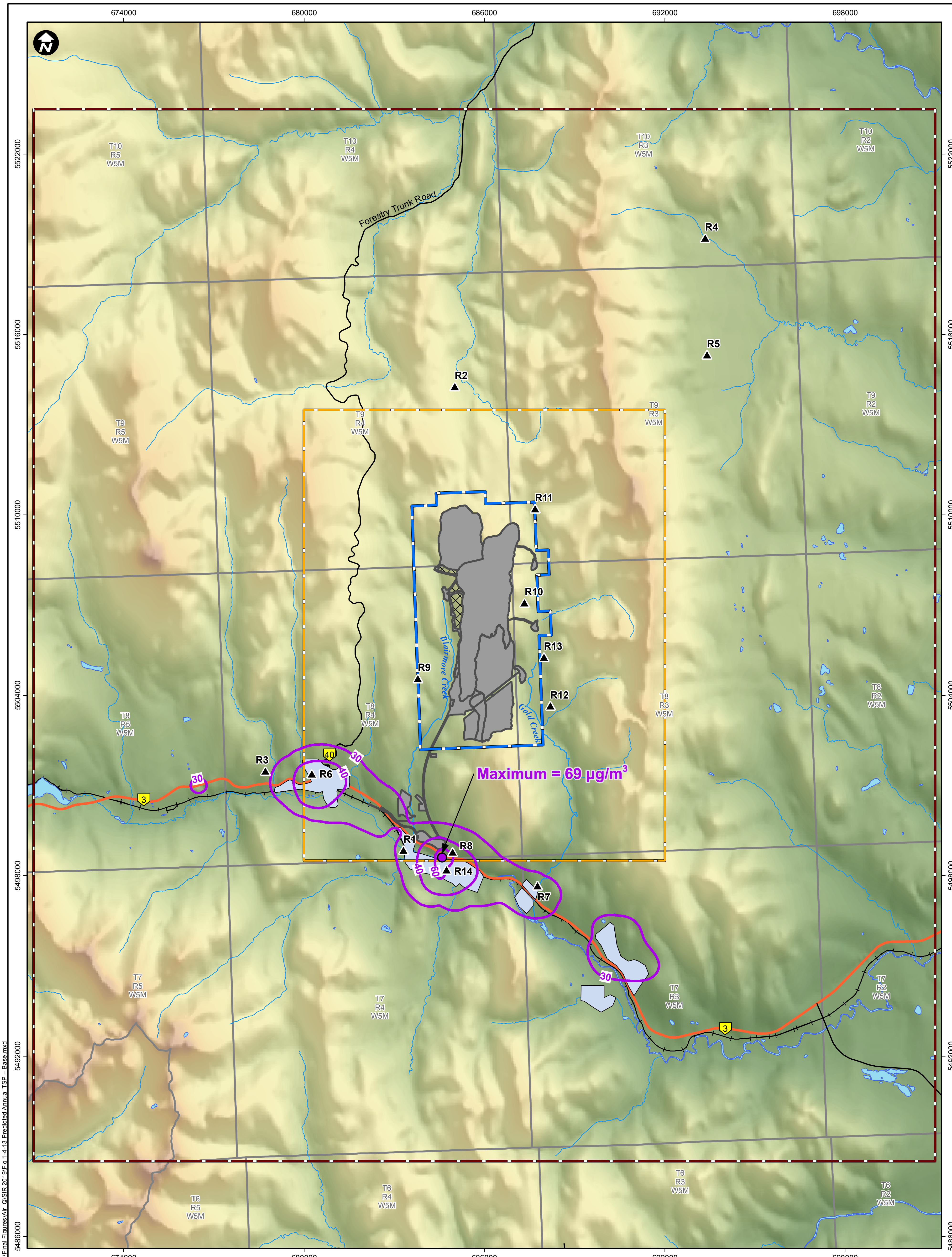
CHECKED BY: JS

DATE: APRIL 16, 2019

FIGURE

1.4-12

Document Path: K:\Active Projects 2014\AP 14-00201 to 14-00250\14-00201\MXD\Final Figures\Air_OSIR 2019\Fig 1-4-12 Predicted Max 24-hour TSP – App50.mxd



LEGEND

- ▲ Special Receptor
- Concentration Isopleth
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- Air Quality Local Study Area
- Air Quality Regional Study Area

Topography (masl)
High : 2800
Low : 1250

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

PREDICTED ANNUAL TSP CONCENTRATION (µg/m³) – UPDATED BASELINE

AltaLIS, 2019; Deswik, 2016; Golder, 2016; MEMS, 2019; Riversdale, 2019

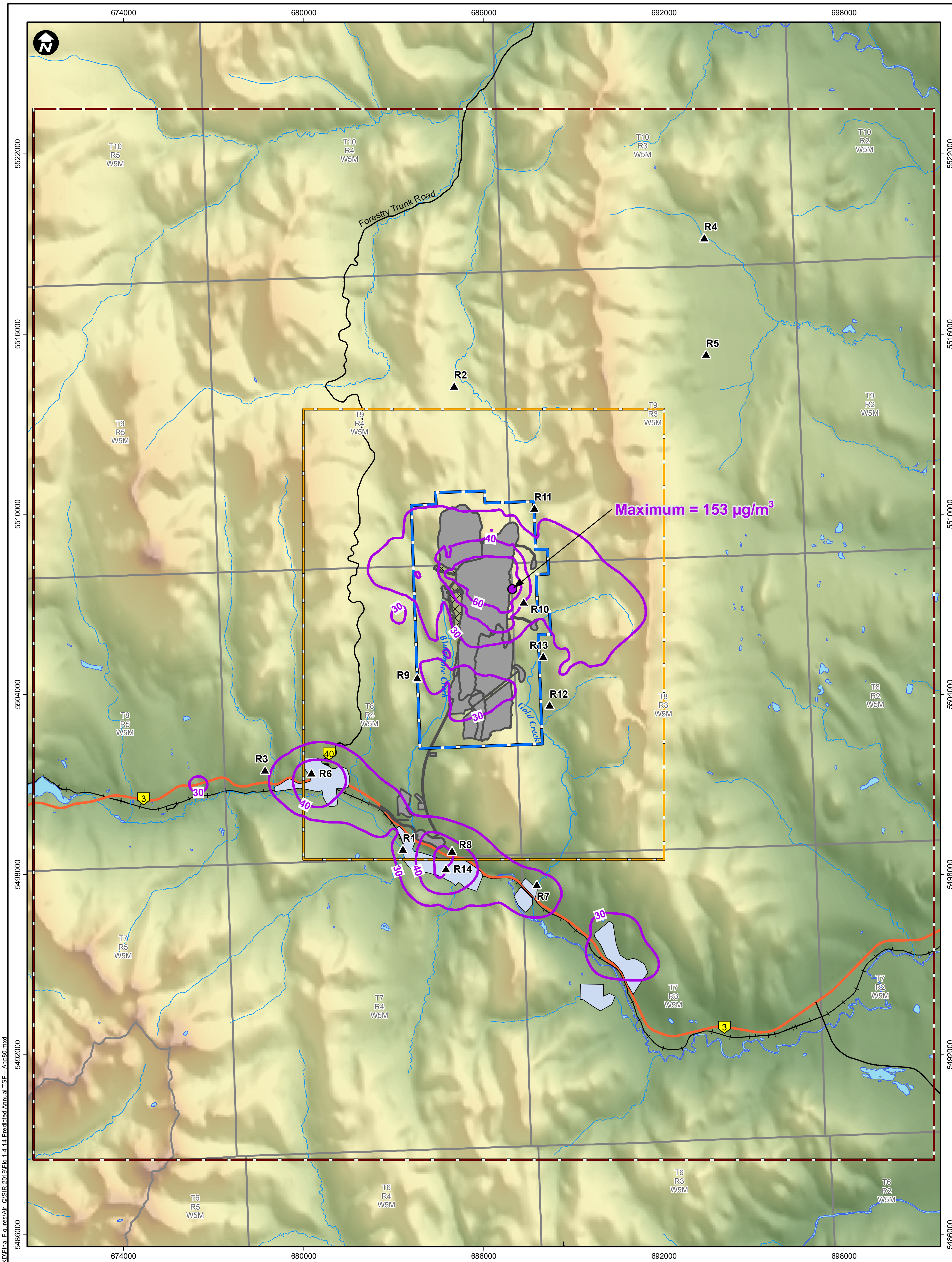
Coordinate System: NAD 1983 UTM Zone 11N

0 4 8
Kilometres

MILLENNIUM EMS Solutions Ltd.

PROJECT: 14-00201-07
DRAWN BY: DCHEN
CHECKED BY: JS
DATE: APRIL 16, 2019

FIGURE
1.4-13



Document Path: K:\Active Projects 2014\AP 14-00201 to 14-00250\14-00201\MXD\Final Figures\Air_QISIR 2019\Fig 1-4-14 Predicted Annual TSP – App80.mxd

LEGEND

- Special Receptor
- Concentration Isopleth
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- Air Quality Local Study Area
- Air Quality Regional Study Area

Topography (masl)
High : 2800
Low : 1250

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

PREDICTED ANNUAL TSP CONCENTRATION (µg /m 3) UPDATED APPLICATION WITH 80% ROAD CONTROL EFFICIENCY

MILLENNIUM EMS Solutions Ltd.

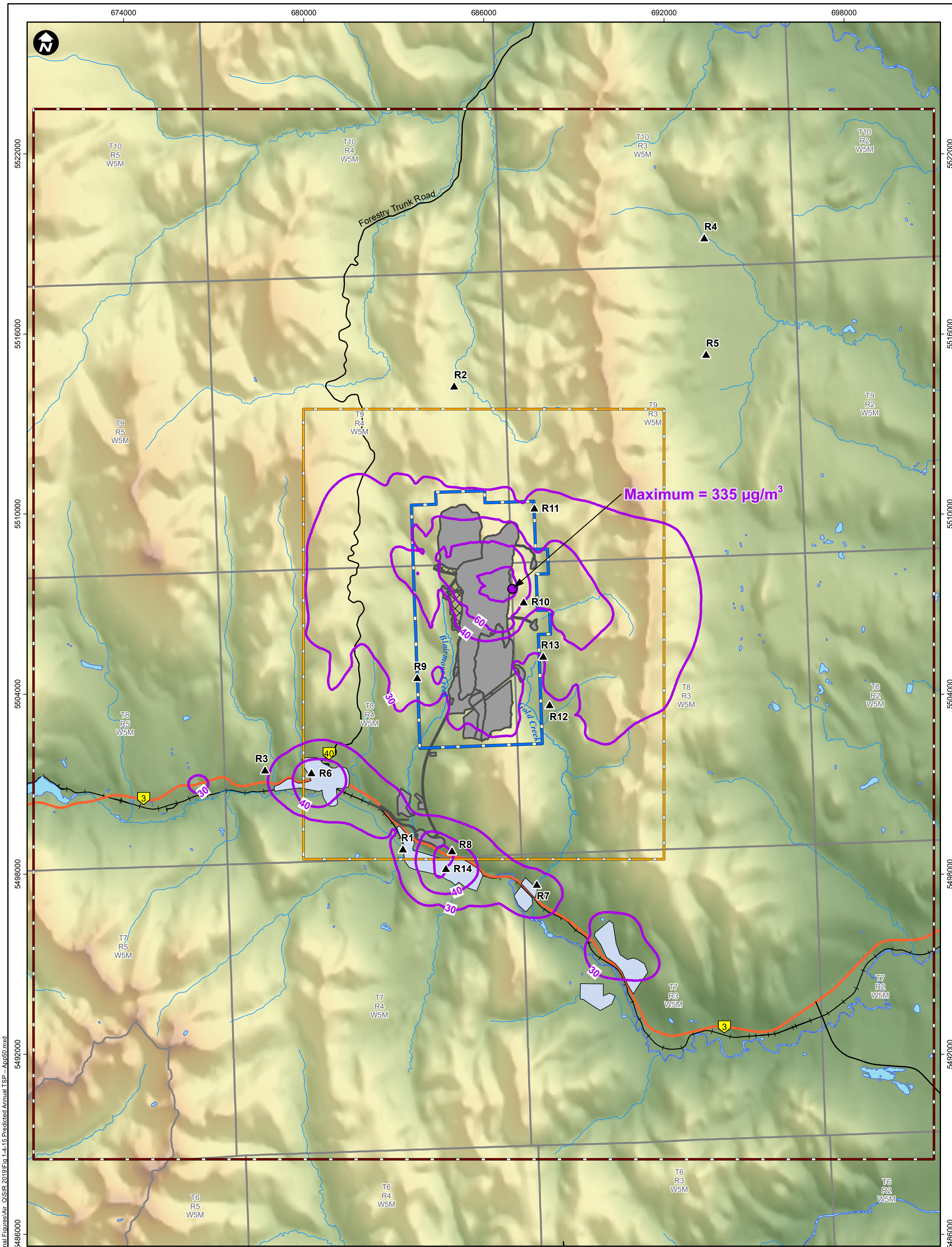
AltaLIS, 2019; Deswik, 2016; Golder, 2016; MEMS, 2019; Riversdale, 2019

Coordinate System: NAD 1983 UTM Zone 11N

0 4 8
Kilometres

PROJECT: 14-00201-07
DRAWN BY: JLAMBERTS
CHECKED BY: TB
DATE: JULY 10, 2019

FIGURE
1.4-14



Document Path: K:\Active Projects 2014\AP 14-00201 to 14-00250\14-00201\MXD\Final Figures\Air_QISIR 2019\Fig 1-4-15 Predicted Annual TSP - App50.mxd

LEGEND

- ▲ Special Receptor
- Concentration Isopleth
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- Air Quality Local Study Area
- Air Quality Regional Study Area

Topography (masl)
High : 2800
Low : 1250

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

PREDICTED ANNUAL TSP CONCENTRATION (µg /m 3) UPDATED APPLICATION WITH 50% ROAD CONTROL EFFICIENCY

AltaLIS, 2019; Deswik, 2016; Golder, 2016; MEMS, 2019; Riversdale, 2019

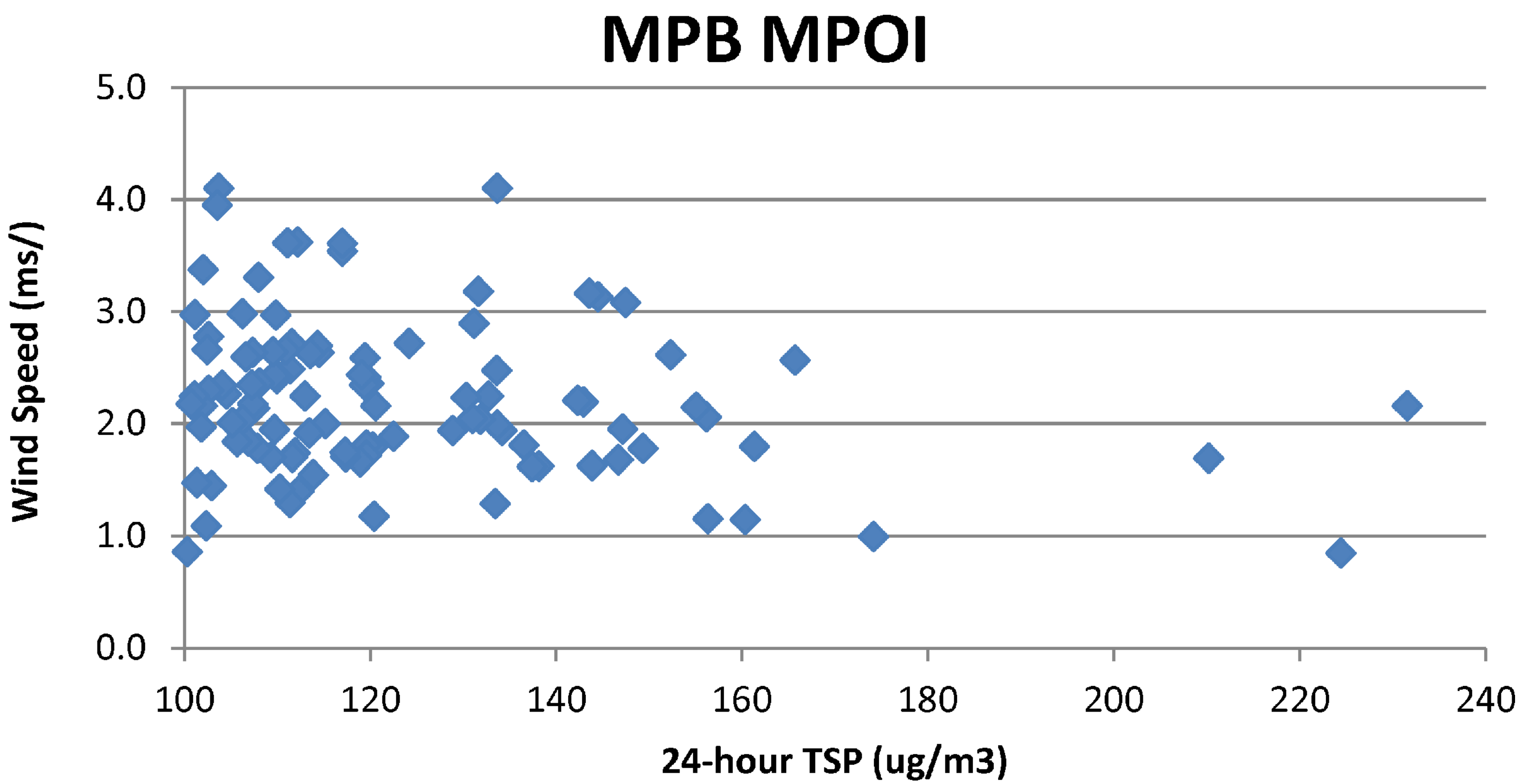
Coordinate System: NAD 1983 UTM Zone 11N

0 4 8
Kilometres

MILLENNIUM EMS Solutions Ltd.

PROJECT: 14-00201-07
DRAWN BY: JLAMBERTS
CHECKED BY: TB
DATE: JULY 10, 2019

FIGURE
1.4-15



RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

MILLENNIUM EMS Solutions Ltd.

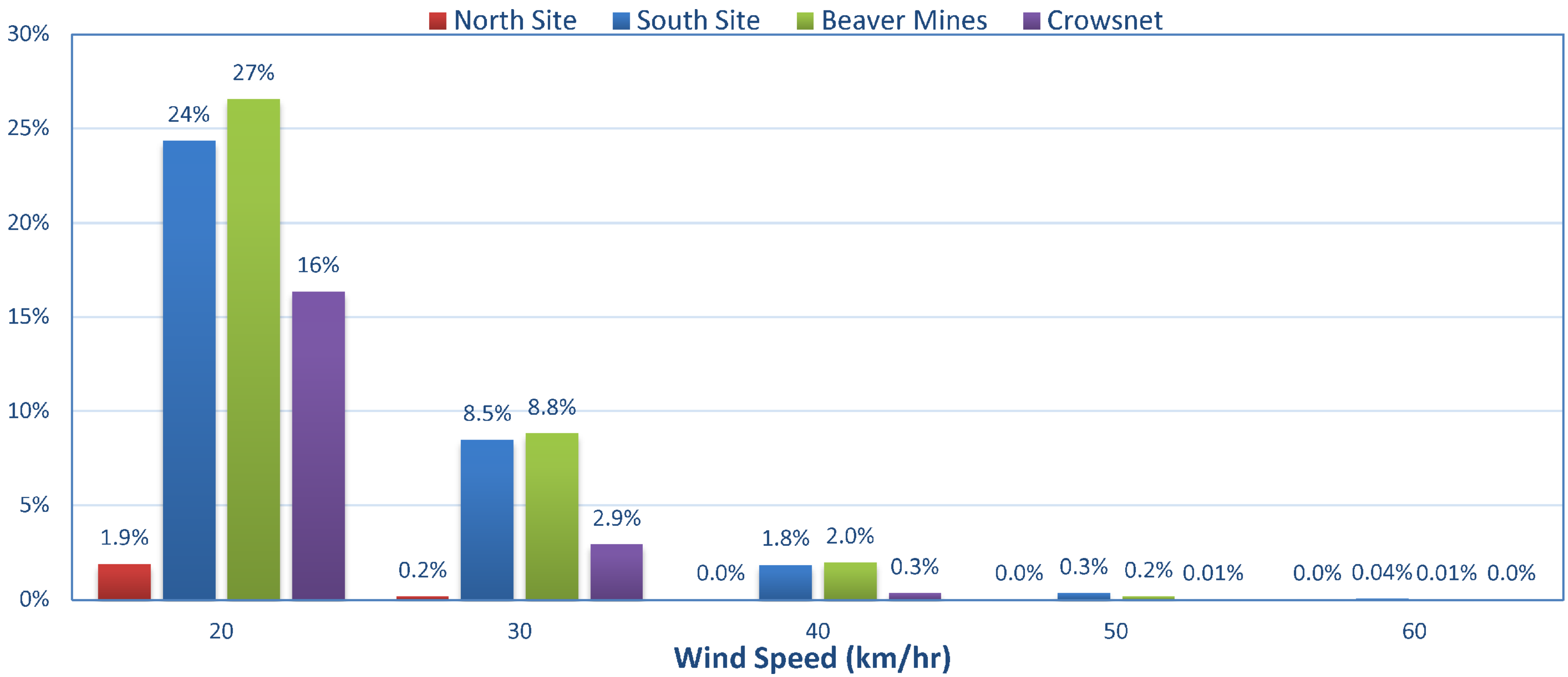
PREDICTED EXCEEDED 24-HOUR TSP CONCENTRATIONS
AT MPB MPOI VS. WIND SPEED

MEMS, 2019

PROJECT: 14-00201
DRAWN BY: JLAMBERTS
CHECKED BY: MB
DATE: MAY 9, 2019

FIGURE
1.5-1

Document Path: K:\Active Projects 2014\AP 14-00201 to 14-00250\14-00201\MXD\Final Figures\Air_Q\Resubmission\Information Request 2019-05-09\Fig 1-5-1 Predicted Exceeded 24-Hour TSP Concentration 14-00201.mxd



RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

MILLENNIUM EMS Solutions Ltd.

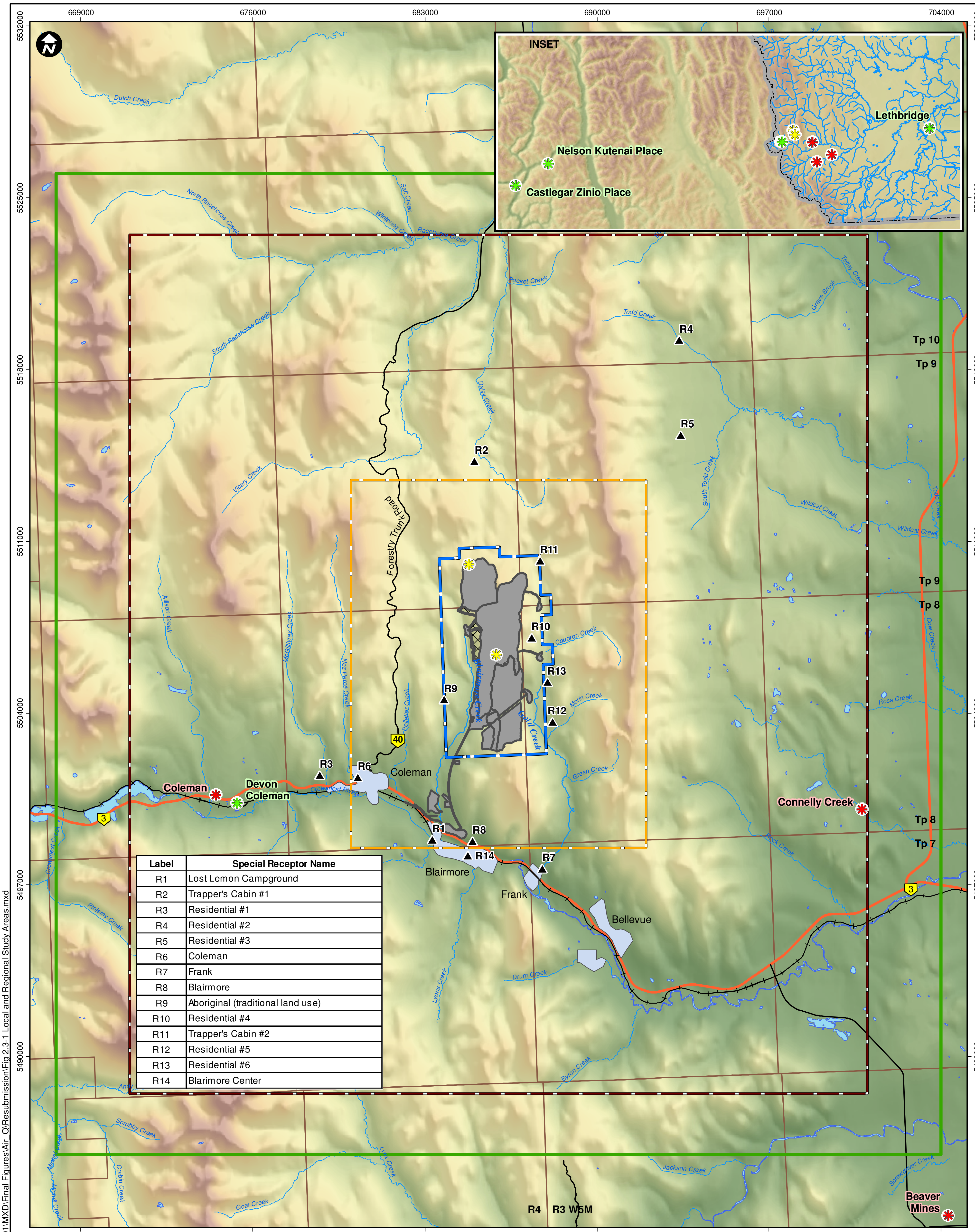
FREQUENCY DISTRIBUTION OF HIGH WINDSPEEDS AT FOUR AIR MONITORING STATIONS

PROJECT: 14-00201
DRAWN BY: JLAMBERTS
CHECKED BY: MB
DATE: MAY 9, 2019

MEMS, 2019

FIGURE 1.5-2

Document Path: K:\Active Projects 2014\AP 14-00201 to 14-00250\14-00201\MXD\Final Figures\Air_Q\Resubmission\Information Request 2019-05-09\Fig 1-5-2 Frequency Distribution of High Windspeeds 14-00201.mxd



Label	Special Receptor Name
R1	Lost Lemon Campground
R2	Trapper's Cabin #1
R3	Residential #1
R4	Residential #2
R5	Residential #3
R6	Coleman
R7	Frank
R8	Blairmore
R9	Aboriginal (traditional land use)
R10	Residential #4
R11	Trapper's Cabin #2
R12	Residential #5
R13	Residential #6
R14	Blarimore Center

LEGEND

- Special Receptor
- AQ Monitoring Station
- EC Meteorological Station
- Focus Monitoring Stations
- Proposed Mine Permit Boundary
- Project Footprint
- Undisturbed Area
- Air Quality Local Study Area
- Air Quality Regional Study Area
- Model Domain

Topography (masl)
High : 2500
Low : 1300

PROJECT

RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

MILLENNIUM EMS Solutions Ltd.

TITLE

AIR QUALITY LOCAL AND REGIONAL STUDY AREAS

NOTES

AltaLIS, 2016; GeoBase, 2016; NRCAN, 2016; Riversdale, 2016
Datum/Projection: UTM NAD 83 Zone 11

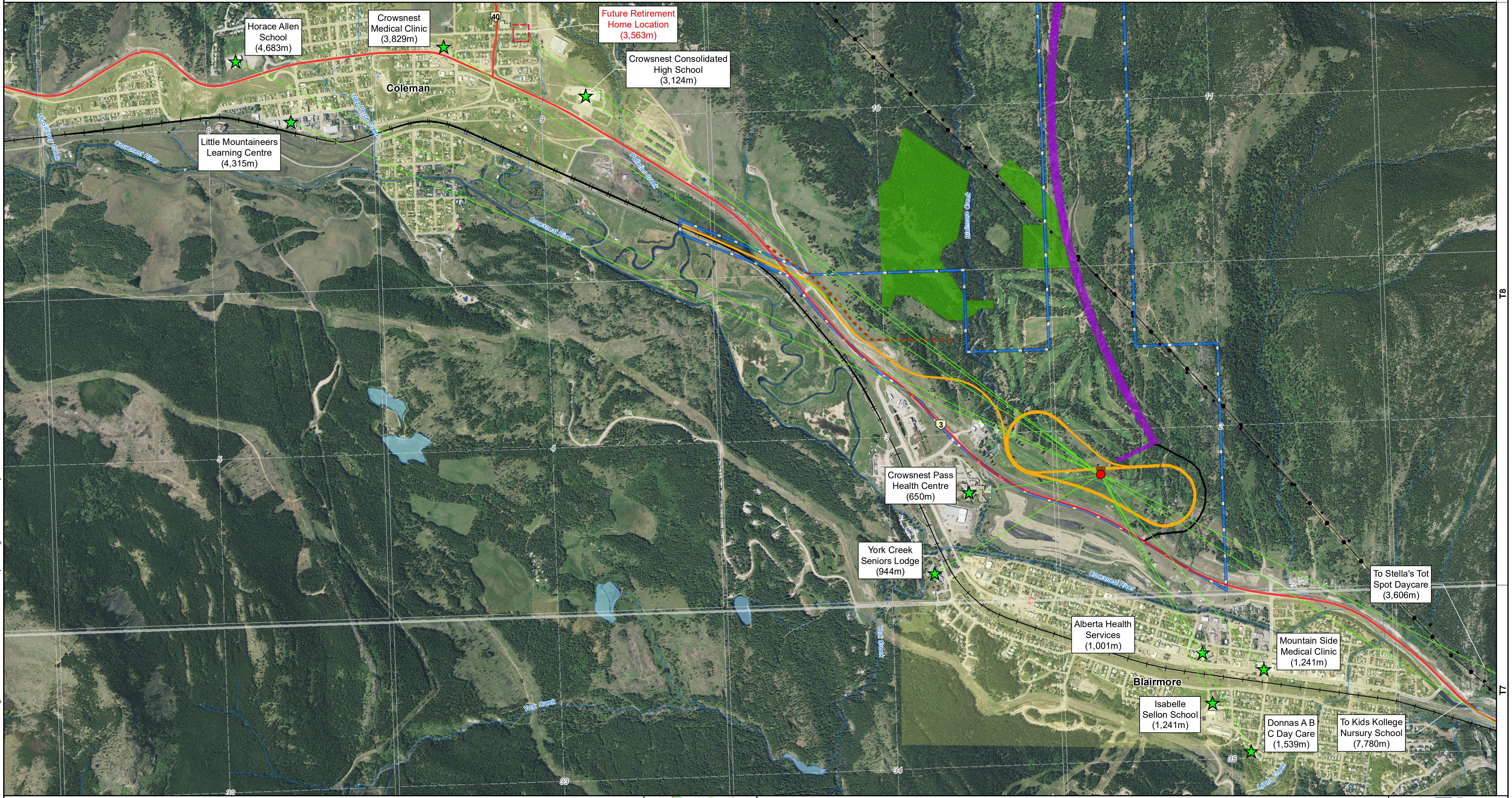
0 2.5 5 10
Kilometres

PROJECT: 14-00201-01
DRAWN BY: JDC
CHECKED BY: RR
DATE: May 30, 2019

FIGURE
1.6-1

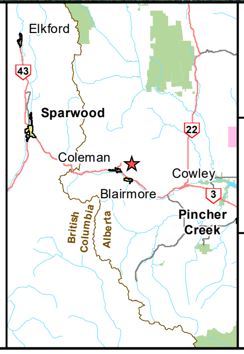
Document Path: K:\Active Projects 2014\AP 14-00201 to 14-00250\14-00201\MXD\Final Figures\Air Q\Resubmission\Fig 2.3-1 Local and Regional Study Areas.mxd

R4 W5M



LEGEND

- Train Load Out
- Primary Highway
- Existing Access Road
- Existing Powerline
- Proposed Railway Loop
- Proposed Helipad Access
- Access Road
- Rail Loadout
- Powerline
- Railway
- Watercourse (Definite)
- Watercourse (Indefinite)
- Waterbody (Definite)
- Waterbody (Indefinite)
- Proposed Mine Permit Boundary
- Covered Conveyor, Access Road and Powerline ROW
- Proposed Golf Course Area



RIVERSDALE RESOURCES

GRASSY MOUNTAIN COAL PROJECT

MILLENNIUM EMS Solutions Ltd.

DISTANCE OF SENSITIVE RECEPTORS TO TRAIN LOAD OUT

PROJECT: 14-00201	
DRAWN BY: JLAMBERTS	
CHECKED BY: MB	
DATE: MAY 27, 2019	

AltaLIS, 2019; MEMS, 2019; Valtus, 2019 (Image Date: 2009/2010)

Coordinate System: NAD 1983 UTM Zone 11N

0 500 1,000 Metres

FIGURE 1.9-1

Document Path: K:\Active Projects 2014\AP 14-00201 to 14-00250\14-00201\MXD\Final Figures\Landuse\Resubmission\Information Request 3\Fig 1-9-1 Noise Proximity 14-00201.mxd

APPENDIX 1.1-1: PDS – ENVIROBIND DCT

IPAC CHEMICALS LTD

POWER CHEMICALS LTD

Product Data Sheet

Envirobind DCT

High Performance Dry Powder Rail Car Topper

Product Description:

Envirobind DCT is a proprietary high performance, custom-formulated rail car topping additive which provides unequalled performance on metallurgical and thermal coal during prolonged transportation under extreme heat and high wind conditions. Envirobind DCT provides extremely fast wetting of the hydrophobic coal surface, thereby producing a continuous coating. The formulation of proprietary components ensures excellent penetration of the strength component, thereby creating a thick, hard crust. The product is environmentally friendly and is not controlled under TDG Regulations. The product contains no heavy metals and will not affect the coking process. Application of Envirobind DCT is best achieved through a dry polymer make-down system. Optimal recommended concentration at the application is 0.1% to 0.2%.

Application Recommendations:

Minimum dosage recommendation is 200 grams per car, or approximately 30 kg per 152-car train.

General Specifications

Appearance	off-white powder
Odor	faint
Specific gravity	0.80 ±0.05
pH	7(1% solution)
Water	soluble
Flash Point	none
Aquatic Toxicity (LC_{50}96 hr) As Applied	>10,000 mg/L

For more information and technical support, please contact your local Power Chemicals Account Manager.

APPENDIX 1.1-2: SDS – ENVIROBIND DCT

Safety Data Sheet

Envirobind DCT

SECTION 1. IDENTIFICATION

Product Identifier	Envirobind DCT
Other Means of Identification	Envirobind DCT
Product Family	Envirobind
Recommended Use	Rail car top treatment.
Restrictions on Use	None known.
	POWER Chemicals LTD, 1620 West 75th Ave., Vancouver, BC, V6P 6G2, Canada, 604 263 0803, www.powerchem.net
Emergency Phone No.	Canutec, 613-996-6666, 24 hours

SECTION 2. HAZARDS IDENTIFICATION

GHS Classification

Acute toxicity (Oral) - Category 4; Acute toxicity (Dermal) - Category 4; Skin corrosion/irritation - Category 2; Serious eye damage/eye irritation - Category 2A

GHS Label Elements

Warning
Harmful if swallowed.
Harmful in contact with skin.
Causes skin irritation.
Causes serious eye irritation.

Prevention:
Wash hands and skin thoroughly after handling.
Do not eat, drink or smoke when using this product.
Wear protective gloves/protective clothing.
Wear eye protection/face protection.

Response:
IF ON SKIN: Wash with plenty of water.
IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
Call a POISON CENTRE/doctor if you feel unwell.
If skin irritation occurs: Get medical advice/attention.
If eye irritation persists: Get medical advice/attention.
Take off contaminated clothing and wash it before reuse.

Dispose of contents/container in accordance with local, regional, national and international regulations.

Other Hazards

None known.

SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS No.	%	Other Identifiers
Alkyl Ester	**	**	**

Notes

** HMIRC 9291, granted March 3, 2015
Concentrations are expressed in % weight/weight.

SECTION 4. FIRST-AID MEASURES

First-aid Measures

Inhalation

Move to fresh air. If breathing is difficult, trained personnel should administer emergency oxygen if advised to do so by Poison Centre or doctor. Call a Poison Centre or doctor if you feel unwell or are concerned.

Skin Contact

Wash gently and thoroughly with lukewarm, gently flowing water and mild soap for 5 minutes. If skin irritation occurs get medical advice/attention. Thoroughly clean clothing, shoes and leather goods before reuse or dispose of safely.

Eye Contact

Immediately rinse the contaminated eye(s) with lukewarm, gently flowing water for 15-20 minutes, while holding the eyelid(s) open. If eye irritation persists, get medical advice/attention.

Ingestion

Never give anything by mouth if victim is rapidly losing consciousness, or is unconscious or convulsing. Do not induce vomiting. Rinse mouth with water. Call a Poison Centre or doctor if you feel unwell or are concerned.

Most Important Symptoms and Effects, Acute and Delayed

If inhaled:
At high concentrations can irritate the nose and throat. Can harm the kidneys. Can harm the liver. Symptoms may include headache, nausea, dizziness, drowsiness and confusion. A severe exposure can cause unconsciousness.
If on skin:
Symptoms include pain, redness, and swelling.
If in eyes:
May cause moderate to severe irritation.
If swallowed:
Large amounts can harm the kidneys. Can harm the liver.

Immediate Medical Attention and Special Treatment

Target Organs

Eyes, skin.

Special Instructions

Not applicable.

Medical Conditions Aggravated by Exposure

None known.

SECTION 5. FIRE-FIGHTING MEASURES

Extinguishing Media

Suitable Extinguishing Media

Carbon dioxide, dry chemical powder or appropriate foam.

Unsuitable Extinguishing Media

None known.

Specific Hazards Arising from the Chemical

Can ignite if strongly heated.
Heating increases the release of toxic vapour. Solutions of product are extremely slippery.
In a fire, the following hazardous materials may be generated: very toxic carbon monoxide, carbon dioxide; corrosive, oxidizing nitrogen oxides; corrosive sulfur oxides.

Special Protective Equipment and Precautions for Fire-fighters

Dust explosion hazard. Use water spray or fog to prevent dust formation and minimize risk of explosion.
See Skin Protection in Section 8 (Exposure Controls/Personal Protection) for advice on suitable chemical protective materials.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Personal Precautions, Protective Equipment, and Emergency Procedures

Do not touch damaged containers or spilled product unless wearing appropriate protective equipment. Use the personal protective equipment recommended in Section 8 of this safety data sheet. Remove or isolate incompatible materials as well as other hazardous materials.

Environmental Precautions

It is good practice to prevent releases into the environment. Do not allow into any sewer, on the ground or into any waterway.

Methods and Materials for Containment and Cleaning Up

Dike spilled product to prevent runoff. Ventilate the area to prevent the gas from accumulating, especially in confined spaces. Remove or recover liquid using pumps or vacuum equipment. Contain and soak up spill with absorbent that does not react with spilled product. Place used absorbent into suitable, covered, labelled containers for disposal.

SECTION 7. HANDLING AND STORAGE

Precautions for Safe Handling

Prevent accidental contact with incompatible chemicals.
It is good practice to: avoid breathing product; avoid skin and eye contact and wash hands after handling.

Conditions for Safe Storage

Store in an area that is: cool, dry. See advice on temperature in Conditions to Avoid in Section 10 (Stability and Reactivity) to determine suitable storage temperature.

SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control Parameters

Not available.

Appropriate Engineering Controls

General ventilation is usually adequate. Provide eyewash and safety shower if contact or splash hazard exists.

Individual Protection Measures

Eye/Face Protection

Wear chemical safety goggles.

Skin Protection

Prevent skin contact. In case of an emergency (e.g. an uncontrolled release): wear chemical protective clothing e.g. gloves, aprons, boots.

Respiratory Protection

Concentrated product: not usually required when working with small quantities. Product (diluted as directed): wear a NIOSH approved air-purifying respirator with an appropriate cartridge.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Basic Physical and Chemical Properties

Appearance Light tan powder. Particle Size: Not available

Odour	Odourless
Odour Threshold	Not applicable
pH	Not available
Melting Point/Freezing Point	Not available (melting); Not applicable (freezing)
Initial Boiling Point/Range	Not applicable
Flash Point	Not applicable
Evaporation Rate	Not available
Flammability (solid, gas)	Not available
Upper/Lower Flammability or Explosive Limit	Not applicable (upper); Not applicable (lower)
Vapour Pressure	Not applicable
Vapour Density (air = 1)	Not applicable
Relative Density (water = 1)	Not available
Solubility	Not available in water; Not applicable (in other liquids)
Partition Coefficient, n-Octanol/Water (Log Kow)	Not applicable
Auto-ignition Temperature	Not applicable
Decomposition Temperature	Not applicable
Viscosity	Not applicable (kinematic)

Other Information

Physical State	Solid
Molecular Formula	Not applicable
Molecular Weight	Not applicable
Bulk Density	Not available
Surface Tension	Not applicable
Vapour Pressure at 50 deg C	Not available

SECTION 10. STABILITY AND REACTIVITY

Reactivity

None known.

Chemical Stability

Normally stable.

Possibility of Hazardous Reactions

Not applicable.

Conditions to Avoid

Heat. Incompatible materials. Generation of dust. Temperatures above 100 ºC

Incompatible Materials

Strong reducing agents (e.g. hydrides), strong oxidizing agents (e.g. perchloric acid).

Hazardous Decomposition Products

Not applicable.

SECTION 11. TOXICOLOGICAL INFORMATION

Likely Routes of Exposure

Inhalation; eye contact; skin contact; skin absorption; ingestion.

Acute Toxicity

LC50: No information was located.

Alkyl Ester: LD50 (oral, rat) > 500 mg/kg

LD50 (dermal): No information was located.

Skin Corrosion/Irritation

May cause moderate or severe irritation based on information for closely related materials.
SKIN IRRITANT. Symptoms include pain, redness, and swelling.

Serious Eye Damage/Irritation

There is limited evidence of mild irritation.
May cause moderate to severe irritation.

STOT (Specific Target Organ Toxicity) - Single Exposure

Inhalation

At high concentrations: can irritate the nose and throat. Can harm the kidneys. Can harm the liver. Symptoms may include headache, nausea, dizziness, drowsiness and confusion. A severe exposure can cause unconsciousness.

Ingestion

If large amounts are ingested: can harm the kidneys. Can harm the liver.

No information was located for: Skin Corrosion/Irritation, STOT (Specific Target Organ Toxicity) - Single Exposure, Aspiration Hazard, STOT (Specific Target Organ Toxicity) - Repeated Exposure, Respiratory and/or Skin Sensitization, Carcinogenicity, Development of Offspring, Sexual Function and Fertility, Effects on or via Lactation, Germ Cell Mutagenicity, Interactive Effects

SECTION 12. ECOLOGICAL INFORMATION

Toxicity

Harmful to aquatic life, based on acute toxicity tests.
Rainbow trout 96H LC50 = 17.2 mg/L

SECTION 13. DISPOSAL CONSIDERATIONS

Disposal Methods

Recommended disposal methods are for the product, as sold. (Used material may contain other hazardous contaminants). The required hazard evaluation of the waste and compliance with the applicable hazardous waste laws are the responsibility of the user. The preferred waste management options are: bury in a licensed landfill according to federal, provincial/state, and local regulations.

SECTION 14. TRANSPORT INFORMATION

Not regulated under Canadian TDG regulations. Not regulated under US DOT Regulations.

Special Precautions Not applicable

Transport in Bulk According to Annex II of MARPOL 73/78 and the IBC Code

Not applicable

SECTION 15. REGULATORY INFORMATION

Safety, Health and Environmental Regulations

Canada

WHMIS Classification

D2B - Toxic (Skin irritant; Eye irritant)

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the SDS contains all of the information required by the Controlled Products Regulations.

SECTION 16. OTHER INFORMATION

SDS Prepared By Regulatory Affairs

Phone No. 604 261 3019

Date of Preparation January 01, 2016

Date of Last Revision	January 01, 2016
Disclaimer	Every effort is made to ensure that the data presented herein is current and factual; however, no warranty nor any other legal responsibility is to be construed from this document. Numerical values reported represent nominal and/or typical properties and do not constitute specifications. Any use of the information presented herein must be determined by the user to be in accordance with applicable federal, provincial, and local laws and regulations.

APPENDIX 1.1-3: CAR TOPPER TEST

Sedgman Limited
2670 – 650 West Georgia Street
Vancouver BC V6B4N9

Attention:

Power Chemicals Laboratory Report

Subject: Car Topper Evaluation on Riversdale Coal Report

Date: April 25, 2018

Overview:

Riversdale Resources is an incorporated coal development company based in Australia with locations in Alberta that is focused on supplying the international market with quality steel making coal. Currently Riversdale's Grassy Mountain project is in projected to produce 95 MT of coal over a lifespan of 25 years, the vast majority of which will be transported over 1000 km via rail to Westshore Terminals in Delta. Mitigations to reduce the amount of dust released enroute are key to the social license to operate. Performance of car topping chemistry is the focus of this report.

The shipping origin will be the CrowsNest Pass Complex, located approximately 50 km east of the Sparwood, and so could potentially utilize the same techniques to prevent coal dusting during transport. Teck currently uses two treatments; one at each mine site and a secondary treatment at the Tappen facility west of Salmon Arm in BC. Primary treatment at the mine sites is with Envirobind DCT, a dry product, and the secondary treatment is with Envirobind APS, a liquid emulsion product.

However, Riversdale is considering the possibility of designing the initial onsite treatment to last the entire journey in order to reduce operating and capital costs. The purpose of this investigation was to determine the capabilities of using DCT at variable initial dosages to replace the dual treatment of DCT + APS as a control. Dosages of chemistry are reflective of on-site treatments. Standard recommended treatments with DCT and APS are 30 kg per train respectively. When applied properly, this combination has demonstrated very good performance in the field.

Test Methodology:

Riversdale Metallurgical ("nominal") coal (received January 3, 2018) at 9% moisture was sieved through #6 mesh (3.4 mm) to provide consistent, small particle size in order to simulate worst-case conditions, and was used following in-house developed procedures (**SOP 75)** to evaluate crust quality for various formulations. For a better direct comparison and to minimize variable error, DCT/APS and DCT controls were prepared with each batch of samples. To simulate the stress exerted on the coal crust during rail transport, samples were placed on the vibrator for a period of time ranging from one to ten minutes in order to drive the crust to failure. The testing procedure for these vibrated samples was as follows:

1. Prepare, treat coal and dry railcar samples.
2. Use DCT at various concentrations; 1X, 2X and 3X the original concentration.
3. Dry samples under solar lamps overnight.
4. Vibrate on the vibrator in the holder closest to the motor for 1, 5 or 10 minutes
5. Take pictures and measurements and treat Control with APS.
6. Dry samples under solar lamps overnight.
7. Repeat pictures and measurements as needed.
8. High Velocity Wind Tunnel Testing for each sample was conducted to provide simulated performance in the field.

Results and Discussion:

Results displayed in Table 2 are for secondary trials where the concentration of the applied DCT treatment was increased to two and three times the original (the same mass of treatment was applied but the concentration varied). Crust quality is improved as the concentration of applied DCT increases. In fact, the DCT/APS control is much weaker than the concentrated DCT samples.

1. INITIAL CRUST QUALITY

Table 1: Crust quality for Control and different concentrations of DCT.

Crust Evaluations	DCT + APS Control (Jan 31)	DCT Control (Jan 31)	2X DCT Concentration	3X DCT Concentration
Initial crust state	Intact, thin	Intact, thin	Intact	Intact
Crust weight (g)	47.65	41.8	55.68	66.45
Crust thickness, range (cm)	0.7-1.5	0.7-1.7	0.9-2.2	0.9-2.5
Crust thickness, average (cm)	1.3	1.3	1.5	1.7
Break weight (g)	550	800	1000	>1050

2. VIBRATION TESTING

In order to replicate the stresses of rail transport, and to simulate current practices (Control; DCT at mine, APS at Tappen) different durations of vibration were tested. *Control at various vibration times.*

A) Control treatment at various vibration times.

Table 2: Crust quality for samples vibrated for various durations

Crust Evaluations	DCT + APS Control (Feb 6)	DCT + APS Vibrate 1 min	DCT + APS Vibrate 5 min	DCT + APS Vibrate 10min
Initial crust state	Intact	Intact	In 3 pieces	In several pieces
Crust weight (g)	51.94	15.54	12.15	9.63
Crust thickness, range (cm)	0.5-1.3	0.1-0.3	0.1-0.5	0.1-0.2
Crust thickness, average (cm)	0.8	0.2	0.2	0.1
Break weight (g)	550	500	500	450

Observations:
The results in Table 2 show that one minute of vibration was sufficient to significantly reduce the size of the Control crust. Longer vibration reduced the weight and thickness of the crusts significantly. However, the strength of the remaining crust was relatively unchanged over the course of the vibration.

B) Control treatment vs Various DCT Treatments vibrated for 1 minute.

A vibration period of one minute was chosen for the next test as it was thought to reduce variability between samples while stressing samples enough to provide differentiation between treatments.

Table 3: Crust quality of samples after being vibrated for one minute

Crust Evaluations	DCT + APS Control (Feb 26)	1X DCT	2X DCT	3X DCT
Crust state	Intact	3 pieces	Intact	Intact
Crust weight (g)	9.42	7.4	29.42	34.62
Crust thickness, range (cm)	0.1-0.2	0.1 – 0.2	0.3-0.9	0.5-0.9
Crust thickness, average (cm)	0.2	0.15	0.5	0.7
Break weight (g)	450	700	1000	1000

Observations:
The testing showed that crust durability improves through increasing the concentration of DCT to two and three times the original amount. Crust weight, thickness and strength were all superior compared to Control treatment.

C) Vibration testing of Control Treatment vs DCT at various concentrations for 5 minutes.

In order to push the samples to failure, especially the Control treatment, we subjected the samples to longer vibration. In Table 2, it was observed that this time frame caused failure of the Control.

Table 4: Crust quality of samples after being vibrated for 5 minutes.

Crust Evaluations	DCT + APS Control (Mar 5)	DCT Control	2X DCT	3X DCT
Initial crust state	Several pieces	Several pieces	3 pieces	Intact
Crust weight (g)	7.89	4.02	27.11	43.25
Crust thickness, range (cm)	0.1-0.2	0.1-0.2	0.1-1.1	0.7-1.4
Crust thickness, average (cm)	0.1	0.1	0.5	1.1
Break weight (g)	400	400	900	>1000

Observations:
It was clear from this test that the more concentrated DCT treatments produce much higher quality, more durable crusts. Crusts were generally intact, much heavier, thicker and stronger with 2X and 3X treatments with DCT.

3. Wind Tunnel Testing

Test Methodology:
Procedures in **SOP 62** outline proper techniques for operating the high velocity wind tunnel (100 km/hr). Modifications for Riversdale testing include: sieving the coal through sieve 4 (<4.75mm), treating the coal as-is (in terms of moisture), drying treated samples for up to three hours under room conditions, vibrating the samples for 1 minute and then placing it into the wind tunnel for 5 minutes. Each sample went through two cycles of vibration/wind tunnel and weights were recorded before each vibration cycle.

Results:
Table 6: High velocity wind tunnel testing results

	Test#			
	1	2	3	4
Measurement	**3X DCT**	**2X DCT**	**DCT/APS Control**	**DCT Control**
Empty Car Mass (g)	179.49	177.76	179.11	180.77
Car with Coal (g)	1137.37	1132.33	1100.86	1115.94
Mass of Coal (g)	957.88	954.57	921.75	935.17
Amount of DCT Treatment (~85.77g)	85.76	85.77	85.72	85.77
Mass of Treatment + Coal (g)	1043.64	1040.34	1007.47	1020.94
[1]Total mass before (g)	1223.13	1218.1	1186.58	1201.71
[2]Mass of Tray and Coal Before Vibration I 1 (g)	1151.16	1191.5	1186.57	1180.55
Mass of Tray and Coal After Wind tunnel 1 (g)	1150.67	1188.89	1178.63	1175.69
Mass of Coal/Treatment Lost (g) 1 (g)	0.49	2.61	7.94	4.86
% Loss1	0.05	0.21	0.79	0.49
Mass of APS Treatment (g)	-	-	85.78	-
Mass of Tray and Coal Before Vibration 2 (g)	1150.67	1188.89	1232.31	1175.69
Mass of Tray and Coal After Wind tunnel 2 (g)	1150.27	1185.92	1229.08	1172.38
Mass of Coal/Treatment Lost (g) 2 (g)	0.40	2.97	3.23	3.31
% Loss 2	0.04	0.25	0.31	0.33

Total % Loss in Wind tunnel	**0.09**	**0.46**	**1.02**	**0.80**

Notes : 1 and 2 – Sample drying resulted in weight loss.

Observations:

1. There is some inherent variability in this testing as demonstrated by the difference in Loss1 despite duplicate application of DCT for Tests #3 and #4. Every effort was made to standardize the coal, vehicle and treatments.
2. The performance of DCT at standard dosage at the mine provides similar results to DCT/APS treatment. A dust loss of approximately 1% is a significant improvement over polyacrylamide/latex emulsion performance (prior testing in 2015 showed 5-8% losses). This is a very good reflection of current performance in the field when recommended dosages are applied at mine site.
3. Vibration and extended high velocity wind tunnel testing demonstrated that DCT applied at 2 times the standard recommended dosage will reduce dusting by approximately 50%.
4. Vibration and extended high velocity wind tunnel testing demonstrated that DCT applied at 3 times the standard recommended dosage will reduce dusting by approximately 90%.

Conclusions:

Significant improvement in dust suppression for the entire trip from Mine to Port is achieved with a dosage of 3 times standard dosage of Envirobind DCT, approximately 90 kg per 152 unit train.

There is likely the opportunity to optimize dosage and cost effectiveness through direct field evaluation and monitoring, which we can provide to Riversdale.

APPENDIX 1.3-1: DRAFT AIR QUALITY MONITORING AND ADAPTIVE MANAGEMENT PLAN

RIVERSDALE RESOURCES

Draft Air Quality Monitoring and Adaptive Management Plan

Benga Mining Limited
Grassy Mountain Coal Project

July 2019

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1.0 INTRODUCTION

1.1 Purpose of Draft Plan

The following draft Air Quality Monitoring and Adaptive Management Plan (the Plan) has been developed for the Grassy Mountain Coal Project (the Project) to address the Joint Review Panel (JRP) information request (IR) 1.3, which requested the following information:

Provide a draft air quality mitigation and monitoring plan. The plan should include:

a) A description of the potential effects of the Project on air quality that require mitigation,

b) A clear statement of the mitigation objective being pursued and identification of indicators that will be used to determine whether mitigation measures are effective,

c) Details of the proposed monitoring and how the monitoring will measure for Project effects,

d) Thresholds, to which monitoring results will be compared, that will trigger the implementation of alternative management actions or mitigation measures,

e) A description of the technically and economically feasible management actions or mitigation measures that Benga will implement if thresholds are exceeded, and

f) A general description of whether, or how, Benga would propose to consider traditional knowledge in the mitigation and monitoring plan.

The purpose of this Plan is to outline a process to mitigate potential Project effects on air quality, assess mitigation effectiveness through monitoring and adapt mitigation as necessary and possible based on monitoring results. The Plan also provides information on the roles and responsibilities of Benga's employees and contractors and how monitoring results will be communicated to appropriate stakeholders.

This draft Plan has been prepared using the most current information available to date regarding air quality mitigation, monitoring and adaptive management related to the Project. Finalization of the draft Plan will occur following additional consultation with regulators, Aboriginal communities and stakeholders and is an anticipated requirement of the *Environmental Protection and Enhancement Act* (*EPEA*) approval condition, should the Project be approved. It is anticipated that this draft Plan will be periodically updated and reviewed as per expected *EPEA* approval conditions.

1.2 Limitations

The final version of this Plan will incorporate information that is not currently available, including the JRP Report, the Decision Statement, future stages of Project planning and feedback from Aboriginal communities and stakeholders. Benga expects that finalization of this Plan will involve the following steps, which are not necessarily sequential, and which may result in changes to the structure of this document.

- receive the JRP Report and Minister's Decision Statement following the JRP Hearing;
- receive the Alberta *EPEA* approval with conditions;
- understand the current state of relevant provincial and federal regulations and relevant guidelines to be addressed in the Plan;
- continue engaging with regulators, Aboriginal communities and stakeholders to develop more clarity around the indicators, metrics and thresholds or objectives to be used to evaluate mitigation effectiveness;
- finalize details of this plan considering future stages of project planning and engineering, including technical, environmental and commercial details; and
- review final Plan with regulators, Aboriginal communities and stakeholders prior to finalization and submission to appropriate regulators as an anticipated condition of an *EPEA* approval.

2.0 REGULATIONS, APPROVALS AND GUIDELINES

The Regulations, Approvals and Guidelines section of the Plan will list relevant provincial and federal regulations, guidelines and approval conditions relevant to air quality mitigation and monitoring and provide a concordance of how they are addressed in the Plan. In addition to the regulations and approvals listed above, the following guidelines were also used to shape the following monitoring Plan.

- Alberta *EPEA* environmental approval for the Project;
- Alberta Ambient Air Quality Objectives and Guidelines (AENV 2019);
- Climate Change and Emissions Management Act (2017); and
- Emission Guidelines for Oxides of Nitrogen (NO_X) for New Boilers, Heaters, and Turbines Using Gaseous Fuels Based on a review of Best Available Technology Economically Achievable (BATEA) (ESRD 2007).

Federal regulatory instruments might include reference to:

- Canadian Ambient Air Quality Standards (CAAQS);

- Multi-Sector Air Pollutants Regulations (MSAPR);
- Off-Road Compression-Ignition Engine Emission Regulations (Environment Canada 2005); and
- Regulations Amending the Off-Road Compression-Ignition Engine Emission Regulations (Environment Canada 2011).

Instruments relating to air quality monitoring might include reference to:

- Alberta Environment and Parks (AEP) Air Monitoring Directive (2019).

3.0 PLAN GOALS AND OBJECTIVES

The goals of the draft Plan link potential Project effects to mitigation, mitigation objectives to monitoring and monitoring results to adaptive management actions. The specific goals and objectives of this Plan are summarized in Table 3.0-1.

Table 3.0-1 Summary of the Goals and Objectives for the Plan

Goals	Objectives
1. Manage and reduce air emissions from the Project.	a. Reduce fugitive dust emissions from mining, processing and transport. b. Reduce NOx emissions. c. Reduce $PM_{2.5}$ emissions from combustion sources. d. Reduce emissions at the loadout.
2. Monitor air emissions and air quality related to the Project.	a. Establish baseline ambient air quality near the Project site. b. Quantify changes to ambient air quality as a result of Project activity.
3. Continuously improve environmental performance, with the following objectives. As appropriate, consider and adapt mitigation should measurements indicate that Project targets are not being met.	a. Review monitoring results periodically or when complaints are received. b. Implement mitigation measures when opportunities to improve ambient air quality are identified or if set targets are not being met.

4.0 PLAN DEVELOPMENT AND CONSULTATION

4.1 Past Engagement

Benga has engaged with Aboriginal groups regarding air quality in the following manner:

- Provided capacity funding for technical engagement, on a discipline by discipline basis to solicit input into Environmental Impact Assessment methods and to resolve technical issues; and
- Consulted directly with community members and representatives through meetings, open houses, workshops, site tours and Indigenous participation in Project-related baseline field programs.

Benga has reviewed Aboriginal-led traditional use studies, third-party technical reviews and statements of concern and input received from ongoing consultation. Based on these inputs, Benga has documented Aboriginal groups' concerns related to air quality. Aboriginal groups' concerns about air quality to date have focused on the selection process for appropriate emission control technology, especially of dust and the associated mitigation and management actions, and dust accumulation on plants.

4.2 Future Engagement

Benga is committed to continue working with potentially affected Aboriginal groups. Project-specific air quality management and monitoring will be implemented at the local level. These management and monitoring actions will evolve during future stages of planning and engineering and will be modified through the continuous improvement process over the life of the Project according to local and Project-specific needs. Benga will engage with Aboriginal groups to discuss this draft air quality mitigation and monitoring plan and again once it is finalized with the inclusion of comments received from Aboriginal groups, regulators and the community.

4.2.1 Regional Participation and Monitoring

The Project is not located in an Alberta airshed. Benga will join an airshed should one be established.

4.2.2 Project-specific Mitigation and Monitoring

Benga has commenced discussions with Aboriginal groups regarding monitoring plans for the Project. These discussions have not specifically touched on the Project's air quality mitigation and monitoring plans but rather have been directed towards developing a framework for integrating traditional knowledge in the development of environmental monitoring plans. Benga will engage with Aboriginal groups in the future to confirm that the air quality mitigation and monitoring plan accommodates input provided by Aboriginal groups.

Benga will have appropriate feedback mechanisms in place for community and Aboriginal groups to report air quality concerns and for Benga to promptly respond to concerns.

4.3 Aboriginal Agreements

Where Benga and an Aboriginal group enter into an agreement regarding the Project, Benga will uphold ongoing commitments for engagement that have been established in the agreement. The agreements include mechanisms for ongoing community input, consultation on environmental and impact management and monitoring throughout the Project lifecycle.

5.0 MITIGATION PROGRAM

A mitigation program has been developed to manage and reduce air emissions from the Project, as outlined in Table 3.0-1. Benga has already committed to these mitigation measures and expects that they would become part of the anticipated *EPEA* approval for the Project. Table 5.0-1 summarizes the objectives and planned mitigation of the mitigation program.

Most of the actions planned for emission management represent good engineering practice in keeping with professional and societal expectations.

Tier IV compliant haul trucks are proposed for the Project, which will have lower NOx, hydrocarbon compound (HC), carbon monoxide (CO) and $PM_{2.5}$ emissions than previous versions. The use of low sulphur diesel fuel consistent with diesel fuel regulations (ECCC 2012) will reduce SO_2 emissions from the mine fleet.

Benga has committed to requesting of CP Rail that they dedicate their lowest emitting units to the operations at Grassy Mountain, or possibly to make changes to operations at the loadout to minimize emissions.

Mitigation methods are well established to manage emissions from other combustion sources. The plant sources will be fired with propane, which typically provides more complete combustion than liquid or solid fuels. This reduces emissions and coupled with the low sulphur content of the natural gas, reduces SO_2 emissions.

Benga has provided mitigation opportunities for fugitive dust in various Project phases in previous Project-related regulatory information requests, which are summarized below.

Construction Phase

During construction, the following approaches will be used to manage $PM_{2.5}$, PM_{10} and TSP emissions:

- Water (or other dust suppressant) will be systematically applied to access roads, to the plant access road, and to any haul roads under construction to minimize dust using a water truck dedicated to this purpose. An emission control efficiency of 80% during the summer months is targeted from this measure.
- Gravel or crushed rock will be used as the underlay on the haul roads. Gravel is observed to produce less dust than clay and sandy surfaces.
- A grader will be used to maintain the active surface of the access road. This procedure is expected to reduce the effective silt content of the portion of the road where the wheels of the haul trucks travel. The grader blade would tend to move the silt particles to the inactive portion (side) of the road or cover the active portion with coarser material.
- Trees and bushes will be preserved around mines and plant, because they effectively trap dust emissions from construction activities.
- To manage the formation of secondary particulate emissions from combustion emissions, Benga will use ultra-low sulphur diesel during construction.

Operations Phase

During operations, the primary sources of particulate emissions are dust from haul road activity and material handling. Benga has introduced mitigative measures to reduce particulate fugitive emissions along private haul roads and for pit activities. The following mitigation measures were incorporated into emission estimation and dispersion modelling and in the health impact assessment:

- The mine fleet will be regularly upgraded and by Year 19, equipment will be newer and more efficient than assumed in emission estimation. Exhaust emissions from the U.S. EPA Tier 4 (2010) standards were used in Project emission estimates and it is likely that off-road standards will be more stringent by Year 19.
- Water will be systematically applied to haul roads and to the plant access road to minimize dust using a water truck dedicated to this purpose. An emission control efficiency of 80% during the summer months is targeted from this measure.
- Snow cover will be retained on the road as a mitigative measure during the winter months, unless the cover would compromise the safety of vehicle operations. Winter ground is frozen and, since the soil and overburden have elevated moisture contents, there is a reduction of dust emissions at that time.
- Gravel or crushed rock will be used on the haul roads. Gravel is observed to produce less dust than clay and sandy surfaces.

- A grader will be used to maintain the active surface of the road. This procedure is expected to reduce the effective silt content of the portion of the road where the wheels of the haul trucks travel. The grader blade would tend to move the silt particles to the inactive portion (side) of the road or cover the active portion with coarser material.
- Speeds on mine roads will be limited to 50 km/h. Speed reduction does not eliminate total emissions but does reduce acute concentrations/exposure.
- Trees and bushes will be preserved around mines and plant, because they effectively trap dust emissions from mining activities and reduce dust concentrations farther from mining activities.
- The coal processing plant module will be contained within an enclosed area and all coal material handling will be *via* covered conveyors.
- Dust generation from transferring coal from the conveyor to the stock pile will be minimized by the use of luffing stackers (those that can lower and raise their boom) which will minimize the drop height and drop time of the coal.
- Fugitive dust generation will be minimized at the rail load-out, with full cladding on the sides of the load-out structure to create a wind shelter, and with the movable discharge chute of the bin located as close as practical to the coal within the rail cars.
- DCT will be applied at the loadout to reduce wind-blown emissions of coal dust from rail cars during transport.

Decommissioning and Reclamation Phase

During the decommissioning and reclamation phase, the following approaches will be used to manage particulate emissions:

- The mined areas will be reclaimed promptly and backfilled with overburden and soil from pre-stripped areas, and then covered by vegetation which reduces windblown fugitive dust emissions from exposed land.
- Water (or other dust suppressant) will be systematically applied to all roads open during decommissioning and reclamation phases.
- Gravel or crushed rock will be used as the underlay on the open access roads.
- A grader will be used to maintain any remaining active surface of access roads.
- Trees and bushes will be replanted as per the Project's Conservation and Reclamation Plan to effectively trap dust emissions from past mining activities.
- To manage the formation of secondary particulate emissions from combustion emissions, Benga will use ultra-low sulphur diesel vehicles during the reclamation phase.

Table 5.0-1 Mitigation Program

Potential Project Effects	Mitigation Objectives	Mitigation
Fugitive dust emissions	Reduce fugitive dust emissions	• Apply water systematically. Target 80% effectiveness in summer. • Retain snow cover on winter roads, if safe. • Use gravel or crushed rock on the haul roads. • Use a grader to maintain the active surface of the road. • Limit speeds on mine roads to 50 km/h. • Preserve trees and bushes where possible to trap dust. • Coal material handling at coal plant will be *via* covered conveyors. • Use of luffing stackers (those that can lower and raise their boom) at stock piles. • Full cladding on the sides of the load-out structure to create a wind shelter. • Movable coal discharge chute at loadout. • Application of DCT to minimize wind-blown dust from rail cars during transport. • Optimize mine plan to minimize haul distances. • Prompt reclamation with backfilled with overburden and soil from pre-stripped areas, and then covered by vegetation.
NOx emissions	Reduce NOx emissions from combustion sources	• Use Tier 4 compliant haul trucks. • Regularly upgrade the fleet. • Maintain fleet to manufacturer's specifications. • Optimize mine plan to minimize haul distances. • Use propane for coal plant building heating. • Investigate alternative ANFO formulations with lower NOx production.
$PM_{2.5}$ emissions	Reduce $PM_{2.5}$ emissions from combustion sources	• Use Tier 4 compliant haul trucks. • Regularly upgrade the fleet. • Maintain fleet to manufacturer's specifications. • Optimize mine plan to minimize haul distances.

6.0 MONITORING PROGRAM

A monitoring program has been developed to measure the effectiveness of mitigation in monitoring air emissions and air quality related to the Project. A summary of the monitoring program is provided in Table 6.0-1.

The first goal is to estimate emissions from Benga operations and to compare them to emissions used in the air quality assessment (project update and subsequent SIRs).

The second objective is monitoring ambient air quality near Project operations. The location and installation of monitoring will be determined by the monitoring objectives. Benga has recommended two sites:

- one located near the eastern edge of the lease; and
- one located in the community of Blairmore near the loadout facility.

Both sites would measure NO_x, $PM_{2.5}$ and PM_{10} continuously. Benga recommends the use of "indicative" monitoring rather than traditional regulatory monitoring at both sites. Table 6.0-1 provides an overview of the monitoring program to meet the two identified objectives in Section 3.0.

6.1 Discussion of Monitoring Program

The following subsections discuss the mitigation objectives and the proposed monitoring that will be conducted to determine the effectiveness of the mitigation.

Table 6.0-1 Monitoring Program

Potential Project Effects	Mitigation Objectives	Mitigation Monitoring	Indicator	Target
Fugitive dust emissions	Reduce fugitive dust emissions	Implement design features	• covered conveyors • luffing stackers • load-out structure • movable coal discharge chute at loadout	Implemented
		Haul truck speeds	As determined by shift supervisors	< 50 km/h
		Watering or dust suppressant rate of application	Hourly and Daily $PM_{2.5}$ concentrations	Meet AAAQG, AAAQO and CAAQS
		PM_{10} monitoring near plant and loadout	Daily PM_{10} concentrations	Meet BCAQO
NOx emissions	Reduce NOx emissions from combustion sources	Diesel and propane consumption on annual basis	Annual average NOx calculated emissions from emission factor	Achieve Project update annual emissions
		N content in ANFO used on annual basis	Annual average $PM_{2.5}$ calculated emission rate from emission factor	Achieve Project update annual emissions
		NOx monitoring near plant and loadout	Hourly NOx concentrations	Meet AAAQO and CAAQS
$PM_{2.5}$ emissions	Reduce $PM_{2.5}$ emissions from combustion sources	Diesel and propane consumption on annual basis	Annual average $PM_{2.5}$ calculated emissions from emission factor	Achieve Project update annual emissions
		ANFO use on annual basis	Annual average $PM_{2.5}$ calculated emission rate from emission factor	Achieve Project update annual emissions
		$PM_{2.5}$ monitoring near plant and loadout	Daily $PM_{2.5}$ concentrations	Meet AAAQO and CAAQS

7.0 ADAPTIVE MANAGEMENT PROGRAM

Adaptive management is a planned and systematic process for continuously improving environmental management practices by learning about their outcomes. Adaptive management provides flexibility to identify and implement new mitigation measures or to modify existing ones during the life of a project. As per Figure 7.0-1, Benga's adaptive management program is organized into four main components, which are re-evaluated and reassessed in a feedback loop.

Figure 7.0-1 Benga's Adaptive Management Process

Adaptive management is intended to respond to changes and advances in technology to meet specific objectives. Benga will incorporate adaptive management techniques as routine components in all of its environmental management activities. These techniques provide the opportunity to develop and fine-tune the monitoring program using data collected on-site and from other regional operators.

Benga will use the experience gained during the development of the Project, and other successes by the regional coal operators over the next 24 years, to manage and implement an effective monitoring program. Benga will work with other operators of coalmines, AEP, AER and local stakeholders, to further develop criteria and monitoring programs that clearly demonstrate progress toward managing and reducing Project-related air emissions.

With respect to Adaptive Management, Benga is committed to achieving continual improvement in environmental performance. The development and implementation of all monitoring and mitigation identified for the Project and housed in the monitoring and follow-up programs will be tracked in relevant management plans. As site conditions and monitoring dictate, or as new technology emerges, Benga will adaptively manage our site practices and monitoring program to meet the defined objectives. For some programs this would involve regular evaluation of predictive models; which would be clearly defined in each applicable management plan.

If a monitoring and follow-up program identifies that adverse environmental effects are greater than predicted, then Benga will evaluate whether they result in changes to the conclusions presented in the effects assessment. If changes are confirmed, then Benga will evaluate the need for revised mitigation actions and management practices to manage effects. Where the need for revised mitigations is identified, they will be developed and implemented.

7.1 Assess the Problem

Assessing the problem includes an assessment of the uncertainty associated with the mitigation effectiveness, the likelihood that the uncertainty can be reduced and/or, the opportunities to refine or modify the best practices.

Mitigation programs have been developed based on the level of planning detail available at the EIA stage. As Project planning proceeds, the assumptions used at the EIA stage may no longer be relevant and new opportunities for mitigation may arise. Benga strives to continually improve its environmental performance.

Over the life of the Project, Benga expects advances to be made to the emission control technologies and to the monitoring approaches that are adopted. Based on the limited service life of several components, certain pieces of equipment will be scheduled for replacement (*e.g.*, haul truck engines and complete haul trucks). Benga plans to take advantage of future technologies to further reduce emissions when these scheduled maintenance activities take place.

For combustion sources, the ability to confirm emissions through continuous or intermittent monitoring is limited. Estimation based on fuel consumption allows appropriate and timely mitigation management to address any potential performance issues.

For fugitive sources, there is more uncertainty because of the intermittent nature of the emissions. Environmental factors play a part in the rate of fugitive emission generation as well. For example, ambient temperature, precipitation and wind can influence the generation of dust from an active area.

Table 7.2-1 lists the approach Benga plans to use to assess and alter its mitigation strategies to achieve mitigation targets.

7.2 Adaptive Management Process Design

Once the problem has been identified and assessed, the design of the adaptive management program can commence, beginning with determining the best approach to adaptive management. The following are design considerations for the adaptive management program:

- data analysis methods and frequency;
- predicted trajectories for indicators; and
- triggers for action and potential adaptations.

Benga is confident in the mitigation measures selected but acknowledges that a formal process is warranted to optimize the measures, as opportunities to refine aspects of the management strategies are available. This formal process includes the following points:

- Indicators of mitigation effectiveness.
- Predicted trajectories through time for the indicators of mitigation effectiveness.
- A monitoring program designed to allow observed trends to be compared to predicted trajectories.
- Triggers for action, should predicted trajectories and observed trends not align, and a plan of action if and when triggers are pulled.

A summary of the adaptive management program for the Project is provided in Table 7.2-1.

7.3 Implement, Monitor and Evaluate

Once Project development begins and the mitigation has been implemented, effectiveness monitoring will commence and observed trends will be compared to predicted trajectories. An evaluation of the monitoring results will determine if adaptations to mitigation need to be implemented. A sequence of actions is triggered if monitoring data indicate that environmental performance does not meet targets.

The mitigation described throughout the EIA (and as updated) will be incorporated into monitoring plans for the Project. Monitoring protocols will be established soon after Project development begins so that trends and progress can be evaluated. Should indicators meet targets or align with desired trends, business will be conducted as usual. Should indicators not meet targets or trends diverge from the desired trajectory, a sequence of Project-specific actions will be triggered. Prior to adjusting any mitigation, steps will be taken to investigate the observations, as necessary. If required, the following sequence will be followed:

1. Monitoring results will be verified and investigated.
2. Adaptations to mitigation will be identified and evaluated based on monitoring results.
3. Develop a work plan to adapt mitigation or monitoring, if required.

7.4 Adjust the Mitigation as Required

If mitigation adjustments are determined to be required, then they will be implemented with careful consideration to proper planning, approvals, notifications and/ or consultation. In this step of the adaptive management process, the work plan will be implemented. Any required notifications and/or approvals will be obtained before acting to confirm that all interested/affected parties are properly informed. If adjustments to mitigation measures are required, Section 5.0 of this Plan will be updated to reflect the adapted mitigation for the Project.

Table 7.2-1 outlines some adaptive management adjustments that could be implemented if monitoring indicates that air quality targets are not being met. Since the monitoring plan has not been implemented, nor monitoring conducted, these are options for consideration.

Table 7.2-1 Adaptive Management Program

Potential Project Effects	Mitigation Objectives	Mitigation	Adaptations
Fugitive dust emissions	Reduce fugitive dust emissions	• Apply water systematically. Target 80% effectiveness in summer. • Retain snow cover on winter roads, if safe. • Use gravel or crushed rock on the haul roads. • Use a grader to maintain the active surface of the road. • Limit speeds on mine roads to 50 km/h. • Preserve trees and bushes where possible to trap dust • Coal material handling at coal plant will be *via* covered conveyors. • Use of luffing stackers (those that can lower and raise their boom) at stock piles. • Full cladding on the sides of the load-out structure to create a wind shelter. • Movable coal discharge chute at loadout. • Optimize mine plan to minimize haul distances. • Prompt reclamation with backfilled with overburden and soil from pre-stripped areas, and then covered by vegetation.	• Vary watering rate • Alternative dust suppressants • Alternative road surfaces • Site speed management • Vegetation planting • Watering at loadout
NOx emissions	Reduce NOx emissions from combustion sources	• Use Tier 4 compliant haul trucks. • Regularly upgrade the fleet. • Maintain fleet to manufacturer's specifications. • Optimize mine plan to minimize haul distances. • Use propane for coal plant building heating. • Investigate alternative ANFO formulations with lower NOx production.	• Vehicle Maintenance • Engine replacement • ANFO formulation adjustment
$PM_{2.5}$ emissions	Reduce $PM_{2.5}$ emissions from combustion sources	• Use Tier 4 compliant haul trucks. • Regularly upgrade the fleet. • Maintain fleet to manufacturer's specifications. • Optimize mine plan to minimize haul distances Optimize mine planning to reduce haul distances. • Develop and implement an anti-idling program for the mine fleet.	• Maintenance • Engine replacement • Confirm fuel specifications

8.0 IMPLEMENTATION

8.1 Roles and Responsibilities

This section will be included in the final version of the Plan and will outline specific roles and responsibilities for employees and contractors related to the implementation of the Plan.

8.2 Information Management and Reporting

This section will outline how the monitoring results and adaptive management actions will be recorded, stored, tracked and made available to interested stakeholders. Accurate record keeping will be necessary to assess the implementation of the Plan, to measure the effectiveness of management and to develop and implement any necessary improvements.

8.3 Change Management

This section will outline the process for altering any part of this Plan, which may be required due to changes resulting from ongoing adaptive management.

8.4 Communication Management

This section will outline the process that will be used for communicating the results of the program to interested stakeholders.

9.0 REFERENCES

AEP (Alberta Environment and Parks). 2019. Air Monitoring Directive. Available from http://aep.alberta.ca/air/legislation/air-monitoring-directive/

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APPENDIX 1.8-1: GREENHOUSE GAS MANAGEMENT PLAN

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Greenhouse Gas Management Plan
Grassy Mountain Project

Prepared for:
Riversdale Resources / Benga Mines

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1.0 INTRODUCTION

1.1 Purpose of Draft Plan

This draft greenhouse gas management plan for the Grassy Mountain Mine Project (the Project) has been developed to address a Joint Review Panel (JRP) information request and includes the following information:

> *Provide a draft GHG management plan including mitigation measures intended to facilitate achievement of Benga's stated GHG emission goals.*

This plan presents Benga Mine's currently available information regarding air quality mitigation and monitoring related to the Project. The plan will be updated as engineering of the mine progresses and following additional consultation with stakeholders.

1.2 Limitations

The updated version of this plan will rely on information that is not currently available: the JRP Report, the Decision Statement, future stages of Project planning and feedback from Indigenous communities and stakeholders. Benga expects the path forward to update this plan would involve the steps listed below, which are not necessarily sequential, and which may result in changes to the structure of this document.

- Receive the JRP Report and Minister's Decision Statement following the JRP Hearing.
- Receive the Alberta EPEA approval with conditions.
- Understand the current state of relevant provincial and federal regulations and relevant guidelines to be addressed in the plan.
- Continue engaging with regulators, Indigenous communities and stakeholders to develop more clarity around the indicators, metrics and thresholds or objectives to be used to evaluate management effectiveness.
- Update details of this plan considering future stages of project planning and engineering, including technical, environmental and commercial details.

Aspects of this plan overlap with the air quality mitigation and monitoring plan. During the finalization of these plans, some aspects might be combined or relocated to reduce redundancy.

2.0 REGULATIONS, APPROVALS AND GUIDELINES

The Regulations, Approvals and Guidelines section of the plan will list relevant provincial and federal regulations, guidelines and approval conditions relevant to this plan and provide a concordance of how they are addressed in the plan. Provincial regulatory instruments might include reference to:

- Alberta EPEA environmental approval for the Project;
- Climate Change and Emissions Management Act (2017); and
- Carbon Competitive Incentives Regulation (2018).

Federal regulatory instruments might include reference to:

- Clean Fuel Standard;
- Renewable Fuel Regulations;
- Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations (2013); and
- Regulations Amending the Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations (2014).

3.0 PLAN GOALS AND OBJECTIVES

The purpose of this plan is to manage and ultimately reduce emissions of greenhouse gases (in particular, CO_2 and methane) associated with the project, and to provide credible means of tracking emissions that enable continuous improvement. The specific goals and objectives of this plan are to:

- Manage and reduce GHG emissions from the Project, with the following objectives:
  - Develop tracking systems to measure relevant inputs to GHG emissions;
  - Reduce emissions from the Project fleet by reducing the consumption of fossil fuel;
  - Understand emissions from transport of coal by rail and marine vessels and work with contractors to reduce emissions;
  - Understand emissions from use of electricity on the Project and investigate opportunities for use from lower-carbon sources; and
  - Understand the potential for Project-specific fugitive methane emissions from exposed coal.
- Continuously improve environmental performance, with the following objectives:
  - Improve Benga's ability to track GHG emissions at increasing granularity; and
  - Implement mitigation when opportunities for improvement are identified or if set targets are not being met.

4.0 MITIGATION PROGRAM

Most of the actions planned for GHG emission management represent good engineering practice in keeping with professional and societal expectations (Table 4-1).

Diesel Combustion on Site

Emissions will be managed through procurement:

- Benga will use Tier 4 compliant haul trucks;
- The mine fleet will be regularly upgraded and by Year 19, when maximum emissions are forecast under the current mine plan, equipment will be newer and more efficient than assumed in emission estimation;
- Benga will investigate availability of low-carbon fuel; and
- Benga will investigate opportunities to replace some of the planned diesel fleet with electrically operated units.

Emissions will be managed through operational means:

- Speeds on mine roads will be managed. Currently the proposed limit is 50 km/h. Maintaining speed as near as reasonable to optimum reduces fuel consumption and cost;
- Benga will develop a program to minimize idling;
- Benga will optimize mine plan to minimize haul distances; and
- Benga will maintain fleet to manufacturer's specifications.

Rail

Benga has committed to requesting of CP Rail that they dedicate their lowest emitting units to the operations at Grassy Mountain and down the line to the port at Vancouver.

Marine Shipping

Where Benga contracts directly for marine shipping, the shipping contractor will be requested to dedicate their low emitting units to the Transport of Grassy Mountain coal.

Electricity consumption

Coal fired power has been slated for elimination in Alberta during the lifetime of the Project. Benga has estimated that if all coal were replaced with natural gas (a conservative assumption in terms of GHG reduction because additional renewable generation is planned), and assuming the natural gas emission intensity of GHG is about 55% that of coal, the overall GHG intensity of the grid, and Benga's intensity, could be reduced by about 28%. Current Benga projections are that electricity contributes about one-third of lifetime GHG emissions on site. Changes in the future power mix of the grid could reduce project lifetime GHG emissions by about 10% (one-third of 28%). While this is a mitigation measure, it is not one that Benga will pursue independently of a province-wide change.

Wind power is produced in southern Alberta and is an alternative to the use of grid power. At best, with Benga's current power requirements, site-generated GHG emissions could be reduced by about one-third using wind power rather than current grid power. Benga is following potential local sources of wind and solar which are increasingly cost effective.

Coalbed Methane

Realistically, the only feasible type of methane recovery to be deployed at surface mines is pre-mine drainage (U.S. EPA 2008). In theory, some pre-mining degasification and recovery could occur at "gassy" surface mines; however, the low gas content of surface mines relative to that of underground mines makes it unlikely that significant recovery would be technically feasible, let alone cost-effective (Edison Electric Institute and the Electric Industry Climate Initiative 2009). Coal bed methane recovery is not ongoing or being considered on the Grassy Mountain site, as the coal is not considered gassy and therefore methane recovery is not practical.

Table 4-1: GHG Mitigation Program

Potential Project Sources	Mitigation Objective	Mitigation
Site combustion	Reduce emissions from combustion sources	• Use Tier 4 compliant haul trucks • Regularly upgrade the fleet • Maintain fleet to manufacturer's specifications • Optimize mine plan to minimize haul distances • Minimize idling • Investigate availability of low-carbon fuel • Investigate opportunities to replace diesel fleet components with electrical components
Site electricity		• Reduce electricity use through high-efficiency equipment • Increase fraction of renewable electricity used on site

Table 4-1: GHG Mitigation Program

Potential Project Sources	Mitigation Objective	Mitigation
Rail	Reduce emissions from combustion sources	• Encourage contractor use of Tier 4 compliant locomotives • Encourage contractor to regularly upgrade the locomotive fleet and to maintain to manufacturer's specifications • Encourage use of low-carbon diesel
Marine	Reduce emissions from combustion sources	• Encourage contractor to use large fuel-efficient vessels
Fugitive methane	Reduce fugitive methane emissions	• None planned at present

5.0 MONITORING PROGRAM

Diesel Fuel on Site

Benga's largest source of emission is diesel combustion in its fleet which will be used in construction, operations and reclamation stages. Benga will track fuel use in the following ways and apply appropriate emissions factors to estimate emissions:

- Total fuel consumed by Benga will be tracked by fuel orders placed and fuel received *via* invoices from commodity supplier and/or delivery invoices;
- Fuel use of individual vehicles apportioned from total based on the respective distance travelled of each vehicle; and
- Fuel consumed by blasting will be tracked by quantity of ANFO purchased and received *via* invoices.

Benga will require that contractors also provide estimates of fuel use for Benga activities. The requirement for tracking fuel consumption on the Project site by contractors will be a requirement in all Requests for Proposals.

Rail Transport

Benga expects to contract rail transport to CP Rail. Benga has not established a contract with them and not at the level of detail to establish GHG tracking. Benga will investigate the following approaches:

- Use of the RAC GHG Calculator to estimate emissions; and
- Require tracking of fuel used in the transport from the loadout to the port in Vancouver on dedicated trains (or prorated on the basis of tonnage for mixed trains) and apply appropriate emission factors to estimate emissions.

Marine Transport

Shipping contracts are not yet established. Benga plans to require the following:

- Documented fuel use if the vessel is contracted to Benga;
- Estimated fuel use based on tonnage if transport is shared or contracted by others; and
- Information on the vessel make, model, class, age to provide an independent fuel use or emission estimate.

Fugitive Methane

Benga does not plan to measure fugitive methane emissions from exposed seams or piles. Benga will continue to use IPCC emission factors based on production.

Electricity Use

Benga will track electricity through its purchase invoices and on-site metered use and use grid average factors to estimate emissions. Should Benga choose alternative electricity sources (*e.g.*, wind power), adjustments will be made to emission factors.

GHG Verification under CCIR

Finally, Benga expects to be included in the Alberta CCIR large emitters category and will undergo GHG emission verifications annually. Because of this process, it is expected its monitoring and reporting processes will continually improve.

6.0 CONTINUOUS IMPROVEMENT PROGRAM

Based on guidance from the Mining Association of Canada, Benga is committed to the "Towards Sustainable Mining" program. The program provides "a set of tools and indicators to drive performance and ensure that key mining risks are managed responsibly at our members' facilities" (MAC 2016). Within the program is an Energy Use and GHG Emissions Management protocol, which requires companies to establish management programs that focus on management systems, reporting systems and performance targets. These requirements are expected to apply to the Project.

Benga's plan for managing GHG emissions from the Project currently includes the following:

- keeping abreast of regulations and guidelines for reducing GHG emissions;
- developing an understanding of the benchmark requirements for the Grassy Mountain project from the Government of Alberta, assuming the current program is unchanged under the new provincial government;
- identifying additional opportunities to reduce GHG emissions during future stages of engineering; and
- developing a detailed GHG management plan (for implementation during Project operation) that will be based on guidance from provincial and federal governments as well as outcomes of the Joint Review Panel.

7.0 IMPLEMENTATION

7.1 Roles and Responsibilities

The Roles and Responsibilities section will outline specific roles and responsibilities for Benga employees and contractors related to executing the plan.

7.2 Information Management and Reporting

Effective monitoring and record keeping is required to review the implementation of the plan, to measure the effectiveness of management and to develop and implement improvements as required. The Information Management and Reporting section will outline how the monitoring results and adaptive management actions will be recorded, stored, tracked and made available to interested parties.

7.3 Change Management

The Change Management section will outline the process for changing any part of this plan. Changes might be required as part of ongoing adaptive management, or for other reasons. Any significant proposed amendments to the plan will be presented to interested parties before the plan is formally updated.

7.4 Communication Management

The Communication Management section will outline how findings of the program will be communicated to interested parties.

8.0 REFERENCES

Edison Electric Institute and the Electric Power Industry Climate Initiative. 2009. Power Partners Resource Guide. Available at: http://www.uspowerpartners.org/Topics/SECTION6Topic-CoalMineMethane.htm.

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