23 April 2008

Proj. No.: C6272 01 00
File Loc.: Vancouver

Michelle Camilleri
Alberta Environment
1st Floor, Twin Atria building
4999 - 98 Avenue
Edmonton, Alberta T6B 2X3

Dear Ms. Camilleri:

RE: SUPPLEMENTAL INFORMATION REQUESTS - ALBERTA SULPHUR TERMINALS SULPHUR FORMING AND SHIPPING FACILITY

This letter provides responses to the Supplemental Information Requests (SIR's) included in your letter of January 4th, 2008. For ease of reference, each question is reiterated in italics prior to providing the supplemental information.

1.1 PROJECT DESCRIPTION

1. ***Volume I, Section 2.2.4, Page 15****. AST states that "Contingency programs will be needed in the event the international sulphur markets deteriorate and it is not economically viable to form and market the new sulphur production. This will be the responsibility of the sulphur generators". AST states that "the Project does not include facilities for storing excess sulphur in an above-ground block or otherwise. In the event that sulphur markets deteriorate to the extent that sulphur marketing is no longer viable, the Bruderheim facility will simply reduce its operation or become idle."*

   a) *Provide clarification regarding the nature of the agreements that are envisioned between sulphur generators and AST to ensure that AST's contingency plan will be feasible and acceptable to all parties.*

   b) *AST's contingency plan for implications of deteriorating international sulphur market may mean that individual sulphur generators in the area will also have to plan for long-term, on Site*

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sulphur storage. Clarify what the implication(s) of this outcome may be, regarding AST's plans to be a key regional provider for sulphur forming and shipping.

c) *As sulphur blocking was identified as a concern during the community consultation process, confirm that letting the facility idle will not result in sulphur blocking at any stage during the life of the project.*

A. The agreements between AST and the sulphur generators will be for the forming and loading of sulphur whereby AST will accept liquid, degassed sulphur, will form that sulphur into pastilles, and will load the sulphur pastilles onto rail cars. As is currently the case in the sulphur market in western Canada, the sulphur generators are responsible for delivering the degassed liquid sulphur to AST, arranging transport of sulphur pastilles to an appropriate shipping terminal on the West Coast, and for selling the sulphur pastilles to an international buyer. The amount of storage of degassed liquid sulphur available to each of AST's customers on AST's Site will be limited contractually. No additional sulphur will be accepted from a generator after this storage ceiling is reached. Entering into the agreement will demonstrate the sulphur generator's willingness to accept these conditions.

B. The approval, construction and commissioning of AST's proposed Project will provide individual sulphur generators with an option for forming and marketing their product that does not otherwise exist. Accordingly, the Project's presence reduces the likelihood that sulphur blocking will be required at each of the individual sulphur generator facilities in the event that sulphur markets deteriorate. As premium sulphur product is preferred by the ultimate customers, the option to use the Bruderheim facility will increase the opportunity for the sulphur generators to market their sulphur through good and bad times in the sulphur market. The option to utilize other facilities remains with these generators, as does the option to form their own product.

C. AST confirms that idling of the Bruderheim facility will not result in the block storage of sulphur on the Site at any time during the life of the Project.

2. ***Volume I, Section 3.1.2, Page 60.*** *AST only discusses the proposed Site, no alternative sites are discussed.*

a) *What other sites had AST considered other than the proposed Site?*

b) *Provide AST's rationale for choosing the proposed sites* [sic] *instead of alternative sites.*

A. Three additional sites were considered for selection of the proposed sulphur forming and shipping facility. One was located in Beaver County, one was located in Thornhill County, and the final one was located in Strathcona County.

B. The rationale for selecting the proposed Site is presented in detail in Section 3.2.1 of Volume I. The following excerpt from this section summarizes the rationale for site selection. The presence of the two rail lines is the most compelling reason for the selection, as the presence of both rail options will allow sulphur generators to obtain more competitive freight rates, and to access both the Vancouver and Prince Rupert shipping facilities.

The proposed sulphur forming and shipping facility is located in a portion of Section 35-55-20 W4M (the Site). The preferred Site was selected based on the following economic, environmental and Project criteria:

- it is located within the Alberta Industrial Heartland, in close proximity to existing and proposed oil refining and bitumen upgrading facilities that will generate increasing volumes of sulphur as part of Alberta's planned oil sands production operations. To date, none of these facilities have included the capabilities to form and ship sulphur suitable for export.
- it is located along the major transportation corridor connecting the oil sands regions of eastern Alberta, to the municipal and industrial complex of central Alberta. Significant quantities of sulphur are generated in the source areas of eastern Alberta that do not presently have sulphur forming capabilities.
- both Canadian Pacific (CPR) and Canadian National (CN) rail lines run through the Site, providing efficient delivery of liquid sulphur and shipment of formed sulphur, while minimizing disturbance that would otherwise be required to establish rail access to the Site.
- the Site is zoned for Heavy Industrial Use within Lamont County and the Alberta Industrial Heartland.
- the Site possesses natural containment and alkaline buffering capacity, which will effectively reduce the potential for environmental impacts associated with sulphur forming and shipping activities.
- the Site was commercially available at the time that the sulphur forming and shipping facility project was conceived by AST. Purchase and potential subsequent development of the Site does not involve the relocation of any permanent residents. In the interim, the Site continues to be used for agricultural purposes.'

3. ***Volume I, Section 3.2.1, Page 63.*** *AST states, "AST selected the Rotoformer HS process because of its operational track record and because of its excellent emissions performance."*

   a) *Provide emissions performance comparisons between the Rotoformer HS process and the Enersul GX forming technology.*

   A. AST compared the Rotoform HS technology to Enersul Drum Granulation (GX) Technology and Devco Wetprill technology as summarized in Table 3-1 below. AST is not in possession of quantitative performance data for Enersul's GX forming technology. We understand that Shell's Shantz facility, which utilizes the Rotoformer HS process completes air emission performance tests on an annual basis and submits this data to Alberta Environment. Enersul's GX forming technology is used at Balzac, Waterton and Kaybob 3 plants, and we suspect that those plants similarly submit performance data. The rationale for selecting the Rotoformer HS process is presented in Section 2.2 of Volume I. Both processes are considered to be state of the art and produce premium sulphur product. Table 3-1 summarizes the performance specifications for

the forming alternatives that were considered by AST. The Rotoformer HS process was selected primarily for the following reasons:

- active air emission controls are not required;
- water and energy consumption are lower; and
- the forming processes are more easily adapted to varying rates of sulphur throughput.

Table 3-1: Sulphur Forming Technology Selection Criteria

HAZCO

Alberta Sulphur Terminals
Proposed Bruderheim Sulphur Forming and Shipping Facility
Sulphur Forming Selection Criteria

Sulphur Forming Selection Criteria

Criteria	Sandvik Rotoform HS	Enersul Drum Granulation	Devco Wetprill
Capacity at 125 °C	Multiples of 144 or 288 tons/day shipped	Multiples of 500 or 1100 tons/day...shipped?	120 to 1800 tonnes/day
Production Reliability	1 of 4 '3000's down	1 of 1 'GX2's down	1 Integrated wet prill unit
on 500 tonnes/day	= 25% Reduction	= No Production	= no production
Production Reliability	1 of 4 'HS' units	1of 2 'GX2's down	2 Integrated wet prill units
on 1,000 tonnes/day	= 25% reduction	= 50% reduction	= 50% reduction
or 1of 7 '3000's down	= 15% reduction		
Sulphur Supply	120 °C – 135 °C	120 °C-135 °C max.	120 °C - 135 °C
	(but can operate to 150C during upsets)		
Particle Size	96%..2.4 to 4.8 mm dia	75%..2.8 to 5.6 mm	Irregular shapes/granules
	very tight distribution	1-6 mm wide size range	Need screening to classify
	higher uniformity=more stable	pile less stable?	pile less stable?
Size Classification	100% Premium Product	Classify & Re-melt Off-spec	Classify & Re-melt Off-spec
Pastille/Granule	Homogeneous	Layered (Onion-like)	Irregular-shaped Pellets
Sudic SL II Spec	Complies..<2% fines	Complies..<2% fines	No Sudic SL II Compliance
	Moisture..0%	Moisture..<0.5% ..or more?	<3.0 % adheres to pellets?
Loose Density	1.150 kgs/m3	1.153 kgs/m3	1. 32 kgs/m3
Packed Density	1.320 kgs/m3	1.320 kgs/m3	Info Not available
Angle of Repose	28% typical	25-28%...but tendency to lower end	25-28%...but lower tendency
	pastille shape helps stability	round shape/size range issues	round shape/size range issues
Discharge Temp	70 °C - 80 °C	80 °C - 90 °C	Probably < Pastilles
Utilities: Water	1 l/ton, industrial purity	40-50 l/ton, high purity?	38 l/ton, industrial purity?
Max. Chlorides	<100 ppm	<5 ppm..corrosion concerns?	Not available/corrosion concerns?
Exhaust Air	1.5 m3/hr/unit	4.320 m3/hr/unit	Unknown Requirements
Exhaust Treatment	None Required	Filters/Scrubbers Needed	Filters/Scrubbers ???
Release Agent	761 tonnes sulphur / 1liter agent	None	None
Energy Consumed	1.45 kwh/ton	2.6 kwh/ton	1.5 kwh/ton
Steam Consumed	1 kg/ton	2.5+ kg/ton	5 kg/ton
Compressed Air	0.3 m3/hr/unit	4.320 m3/hr/unit	Unknown Requirements
Preventive Maintenance	Monthly	Daily...0.5-2 hrs reported/unit	Monthly
		...Lost Production??	
Maintenance Activities	Single Level	Multiple Levels	Multiple Levels/Heavy parts?
Heat Transfer	Indirect Cooling..cooling water not contaminated	Cooling Medium contacts product directly	Cooling Water contacts product directly..high %?
Startup/Operation	Immediate & Steady Quality/Constant Operation	Some Time Required to make quality product/Temperamental	Some Time Required to make quality product/Temperamental
Turn-down Capability	3 t/hr on RT-3000	10.4 t/hr... but slow to recover quality with changes	Unknown Capability?
without quality issues	9.6 t/hr on RT-HS		Check for quality affects?
H2S Emissions	<5 mg/m3	~30 mg/m3?	Unknown
Safety	Safety Guards in place..no entry necessary	Confined Work Space Entry..Each Unit Daily? ...Safety/Health Risks?	Confined Work Space Entry? Safety/Health Risks?
Capital Cost	Highest	Medium	Lowest

4. ***Volume I, Sections 3.1, 3.2 and 3.7.2, Pages 59 to 64 and 78.*** *AST states, "All dust that is collected in the process will be recycled and placed back in the sulphur feed tanks to be formed."*

   a) *Provide the design details for the dust collection system.*

   b) *Update Figure 3.2-2 to include the dust collection process. Include the expected emission and wastes that will be produced and how they will be handled.*

   A. One of the attractive features of the Rotoformer HS process is that it does not require active dust collection or scrubbing. Hence, there is no active dust collection system to design.

   B. Dust that collects on pavements and on the floor of the processing building will be collected by sweeping, as required, and returned to the liquid sulphur storage tanks for reprocessing. This is a manual process and does not require update of Figure 3.2-2.

5. ***Volume I, Section 3.5.1, Page 70****. Provide a water balance (supply and usage requirements) to and from the surface runoff collection pond to meet the normal, peak and emergency operating cases. For usage requirements, include the rotoformer requirements, cooling, firewater, boiler feedwater and all other water requirements from the pond for ongoing AST operation. Provide alternative water supply to groundwater.*

   The Design Basis Memorandum for the initial construction is presented as Attachment 1. Section 4.3 addresses all water usage for the Project. Make-up water will now be obtained from the Lamont County Water Utility, eliminating the need for groundwater and will be used to maintain a minimum of 6,000 cubic metres of water in the pond for fire fighting purposes. The rate of make-up water to the pond for the initial stage of operation is estimated in Section 4.3.4 of this document to be 6 US gpm. The Lamont County Water Utility has accepted HAZCO as a client as evidenced by Attachment 2.

6. **Volume I, Section 3.5.1, Page 70.** AST states "*AST is in the process of applying for water allotment from the Lamont County Water Utility which would be a suitable alternate supply if an adequate groundwater supply is not confirmed*."

   a) *When will the Lamont County Water Utility make a decision with respect to this application, and what is the contingency if sufficient supply cannot be obtained?*

   A. AST has obtained a commitment from the Lamont County Water Utility (see Attachment 2). As AST understands it, the Utility has no other mechanism to provide further assurances.

7. ***Volume I, Section 3.6.1, Page 76.*** *AST states "The proposed Project will not contribute significantly to GHG emissions as there are no combustion or separation processes that will result in the release of GHG." The process includes a combustion process, and a natural gas fired boiler that will produce 50 lb. of steam.*

   a) *Provide an energy balance.*

   A. It is not clear what energy balance is being considered in this case. At maximum operating rates, the boiler will consume approximately 100 tonnes of gas per month, which will result in approximately 300 tonnes per month of GHG emissions. The boiler produces 50 psi steam for

general heating and maintaining stored sulphur feed in a liquid state. A description of the boiler operations and specifications is provided in Section 4.3.2 of Attachment 1. Further operating details are described in Attachment 1.

1.2 TERRESTRIAL

1.2.1 Terrestrial Ecosystems

8. ***Volume IIC, Sections 3.3.1.2 and 3.3.1.3, Page 3-3.*** *AST states that the boundaries of the LSA and RSA were selected based on project emissions calculated in the air quality modelling portions of the EIA, and in particular that "the RSA was used to evaluate Project effects of potential acid deposition including the lands that fall within the predicted sulphur dioxide emissions isopleths estimated in the 2005 air modelling."*

   a) *Provide the rationale and references used to select the appropriate acid deposition levels as they relate to impacts on local plant physiology.*

   b) *Discuss what literature is available regarding the impacts of sulphur dioxide emissions on native prairie and parkland of the type to the East of the project area, and specifically what impacts there might be on native species composition and abundance (biodiversity).*

   A. The preliminary air quality modelling for the Project indicated that acid deposition would be confined to the Site. Based on these results a 200 m buffer around the Site was selected as the LSA boundary. The predicted acid deposition values for the Project are below plant injury threshold values observed at other sites in Alberta. A summary of these studies was provided in the Vegetation report and is included below:

   'Fugitive sulphur dust deposition due to elemental sulphur granulation and processing which was started in 1979 was measured at a sour gas facility in west central Alberta over five years from 1981–1985 (Mayo et al. 1992). The amount of dust deposition varied with distance from the facility according to prevailing winds ranging from 4,297 kg/ha/y at 0.5 km to 5.2 kg/ha/y at 5.0 km. Studies on the plant communities within the sulphur deposition zones indicated that mosses were the plant type most susceptible to elemental sulphur (Kennedy et al.1985) and that reduced growth observed in pine close to the facility may be caused by chronic exposure to sulphur dust particles. The cell wall properties in *Pinus contorta x Pinus banksiana* were chemically altered which may represent an osmotic adjustment to general environmental stress caused by chronic exposure to S-gas emissions and S-dust deposition. The annual sulphur deposition estimated for the Project of 1.11 kg/ha/y is much lower than the deposition rates in the zones which impacted plant communities at the sour gas facility in west central Alberta.'

   B. Minimal literature is available for the effects of SO_2 emissions on native prairie and parkland of the type to the East of the project area. Many of the studies conducted in Alberta evaluated the effects on coniferous plants and mosses, but few investigated native prairie species. The West Central Airshed Society study by Krupa et al. (2004) evaluated the effects of SO_2 on Saskatoon berry and alfalfa. The predicted SO_2 emissions for the Project are well below the injury threshold values observed by Krupa et al. (2004). Studies conducted in the UK investigating the effects of SO_2 on the grass species *Lolium* and *Dactylis* species showed that photosynthesis was inhibited at 200-300 ppb SO_2 (Darrall 1986). The maximum predicted SO_2

concentration for the Project is 0.002 ug m^{-3} or 0.001 ppb, which is well below the injury threshold values observed by Darrall (1986).

The Biodiversity assessment conducted as part of the EIA (Volume IIC, Section 5) determined that the Project would not affect native species composition and abundance because SO_2 levels are below injury threshold values. Further, the LSA is currently more than 95% disturbed from current agricultural land use or other anthropogenic land uses as described in the Vegetation assessment (Volume IIC, Section 3).

1.2.2 Soils

9. **Volume Application, Section 5.10, Page 14.** AST states, "*Soil monitoring around the facility will be completed a minimum of once every three years...*"

   a) *Provide AST's rationale for the proposed monitoring frequency.*

   A. The three year soil monitoring interval has been selected based on the understanding that soils in the PDA and LSA are rated as having low to moderate sensitivity to acid disposition, and that the rate of sulphur deposition from Project operations as modelled will be 1.11 kg/ha/yr at the Site boundary. With low soil sensitivity and a relatively low rate of deposition, it is expected that the changes in soil chemistry that will be monitored will be taking place over a timescale of years rather than months. The three-year interval has been selected as a reasonable estimate of the time required for significant changes to occur to the soils chemistry as a result of the sulphur handling operations.

10. ***Volume IIA, Sections 2.0 and 2.5.3, Figure 2.5-14, Page 2-60; Volumes IIC, Section 2.6.10, Page 2-46.*** *Based on the sulphur deposition modelling data, AST predicts that the maximum average predicted annual deposition of sulphur at the Site boundary would be 1.11 kg/ha/yr.*

    a) *Explain how the geometric mass mean diameters of the sulphur particulates, dispersed from rotoform stacks and the facility loading area, were established for this model prediction.*

    b) *What estimated proportion of sulphur received for forming and shipping may be potentially subject to particulate dispersion/deposition?*

    c) *What is the relative rate of oxidation of sulphur particles of this geometric mass mean diameter, in soil?*

    A. The grain size distribution for the sulphur pastilles was determined by testing a disturbed sample of pastilles. Sizes less than 2 mm equivalent diameter were considered to be susceptible to dispersion as fugitive dust.

    B. As stated in the basis for the air monitoring section of the EIA, 0.2% of the total sulphur throughput is expected to be susceptible to wind-blown dispersion and reflects that portion of the sulphur grain sizes less than 2 mm.

    C. The rate of sulphur oxidation for this size particle is expected to be relatively rapid and will occur over the typical growing season. Sulphur oxidizing bacteria are essentially dormant during winter months when ambient temperatures approach freezing. This position is based on

work completed by Alberta Sulphur Research Ltd. (ASRL) as well as WorleyParsons' observations monitoring impacts of elemental sulphur around existing sulphur management facilities. Variables effecting sulphur oxidation rates are described in Section 2.6.10 of Volume IIC.

11. **Volume IIC, Executive Summary, Page 2-i.** AST states, "*25.5% and 73.4% of the LSA and PDA, respectively, are underlain by soils known to be previously disturbed and reclaimed during earlier industrial activity in the LSA*".

    a) *Describe the known history of industrial activity in the PDA that accounts for the significant extent of disturbed soils.*

    b) *Describe the nature and extent of soil reclamation/remediation that has been recorded in the PDA.*

    A. With the exception of two well sites that exist on the Site, there is no industrial history of the PDA. The PDA does not interfere with the well site leases and vice versa. The area was stripped in preparation for an industrial facility that was never constructed. The top soils were then replaced.

    During the soil survey of the LSA, significant areas of disturbed profiles were discovered. In order to explain these findings, local landowners were consulted. They indicated that at one time in the early 1980's the site had been cleared in preparation for construction of an industrial facility which was subsequently not constructed and that the site was reclaimed prior to any development on the project taking place. This information was corroborated with the findings of a limited aerial photograph review.

    B. The known disturbance history of the PDA is described in Volume IIC, Section 2.5.1.2.2, and Figure 2.5-2 of Volume IIC. Topsoil was stripped, stockpiled and replaced for an industrial facility that was never constructed. No soil remediation activities have been undertaken on the Site. Documented reclamation at the Site includes only one oil well lease as described in Volume IIC, Section 2.5.1.2.2.

12. **Volume IIC, Appendix I, Section 1.5, Page I-3; Appendix V, Tables V-1 to V-3, Figure V-1, Pages V-3 to V-7.** In conducting the baseline assessment for soil resources, AST examined 60 inspection points within the Local Study Area (LSA) and Project Development Area (PDA). Three inspections were completed in the Regional Study Area.

    a) *Clarify AST's rationale for selecting the 15 locations, out of 60 inspection sites, for sampling and analyses of the soil profile for chemical and physical characterization.*

    b) *For salinity/sodicity data only, AST included an additional 10 locations along the western perimeter of the LSA. Clarify the rationale involved in including these surface soil samples (i.e. 0 to 0.30m depth) in this assessment.*

    c) *The ratio of base cations to Al^{+3}, as well as, base saturation percent are often employed as sensitive indicators of soil acidification. The baseline assessment for soils includes the analyses for regulated metals, however, the concentration of Al+3 was not measured. Clarify AST's rationale for this decision.*

A. Samples were selected for testing to obtain representative soil physical and chemical data for each of the major soil series in the LSA. Sampling was therefore conducted on a subset of field inspection locations based on field observations and professional judgement. Physical and chemical data were required for the reasons described in Volume IIC, Section 2.4.1.1.2. Fifteen locations selected based on field data to represent the major soil series identified during field survey.

B. The ten locations noted along the western boundary of the site (samples 05-13, -16, -29, -20, -22, -23, -25, -27, -28 and -32) were part of a soil investigation conducted at the Site in 2005, prior to initiating the EIA. They provide additional chemical background data for the western part of the Site, and provide additional support to the discussion that the Site is underlain by significant areas of naturally sodic soils. The data are intended to supplement but not replace any of the information gathered during the baseline study.

C. Laboratory analytical parameters selected for the baseline study were those expected to be required for future soil monitoring and those outlined in the AENV air monitoring directive Appendix A-7 (AENV, 1989). Base saturation and exchangeable aluminium are not part of the recommended suite of analyses in this document. Regulated metals were analyzed in select samples to identify any potentially naturally elevated metals concentrations at the Site prior to development.

13. **Volume IID Appendix I, Section 2.2.3, Page 1-10.**

a) *Clarify if the area underneath the soil stockpiles will be stripped of topsoil as well or if a different method will be used to ensure that soil stockpiles will be protected from admixing with the soil underneath the pile.*

A. It is intended to strip the topsoil beneath the proposed topsoil piles.

1.2.3 Land Use and Reclamation

14. ***Volume IID, Appendix I, Section 2.1.1, Page I-7.*** *AST indicates that soil conservation measures will involve separate stripping, salvaging and storing of topsoil and subsoil. An estimated volume of salvaged topsoil is 62,000 m^3. AST states limited subsoil salvage is planned and an estimated volume of 7,800 m^3 is projected.*

a) *Explain what measures AST will take to minimize and control any leachate generated from the subsoil stockpile.*

b) *Describe the potential/planned use(s) for the salvaged subsoil.*

c) *Clarify whether a separate stockpile is planned for the stripped and salvaged disturbed topsoils.*

A. Maintaining an active and robust vegetation cover over the stockpiles and ensuring proper drainage will minimize the potential for leaching from the subsoil stockpiles. As discussed in Volume IID, Section 2, Appendix 1: Section 2.2.2 of the Conservation and Reclamation Plan, subsoil salvage will be minimized to the greatest extent possible. Subsoil removed during the

construction of the surface water runoff pond will be used in establishing design grades within the PDA.

Transportation of subsoil from naturally sodic areas to non-sodic areas will be avoided. Any sodic subsoil requiring long-term stockpiling will be placed in areas with known sodic subsoil characteristics after the topsoil has been stripped and removed. Runoff control may be implemented for sodic subsoil stockpiles if it is deemed necessary by the on site soil scientist after a topographical survey of the stockpiles and the surrounding area has been completed.

B. The main potential use of salvaged subsoil is in establishing design grades in the PDA.

C. Topsoil from previously disturbed areas will be stockpiled separately from other topsoil. The baseline study identified significant admixing between topsoil and subsoil in this material and its contact with undisturbed topsoil from the site will be minimized to maintain the quality of the reclamation materials.

1.2.4 Wildlife

15. ***Volume IIC, Section 4.7.1.3.1, Page 4-26.*** *AST states "changes in soil pH may be reversed by an appropriate soil treatment such as lime application to reduce impacts to wetlands that support amphibians and water birds."*

a) *Discuss any adverse effects or limitations of the practice of using lime application to amend soil pH.*

b) *Discuss the lag time involved from detection of a low pH situation to pH reversal following lime treatment.*

c) *What is the source of lime for soil pH amendment?*

d) *Provide an overview of the management plan for lime application.*

A. The potential adverse effects associated with using lime to neutralize acidic soils include potential windblown dispersion of lime as well as the potentially caustic effects of overdosing with free lime. The potential for wind blown dispersion of lime can be eliminated by applying the lime during low wind conditions and by incorporating the lime directly into the soil. The potential for overdosing with free lime can be eliminated by adding the appropriate amount of lime, or by adding crushed calcium carbonate.

B. Neutralizing products are readily available so there would be minimal lag time (a few days or weeks) between detecting low pH conditions and applying the lime. Typically, the soil monitoring program would be completed in the spring or fall when crops are not being grown. The neutralization program, if required, would occur at the same time. In our experience, the neutralizing effects are realized within a week of applying the lime or calcium carbonate. Application is only effective if it is done when the soil is not frozen.

C. There are many potential providers of lime, calcium carbonate or lime products. Agricultural lime is available commercially and is sold throughout the region. Crushed limestone can be

obtained from quarries located along the eastern slopes of the Rockies (Exshaw, Nordegg) and trucked to the Site.

D. Soil sampling would be completed to determine the levels of total sulphur, elemental sulphur and pH in the upper portion of the topsoil layer (the top 100 mm). Based on the measured values, sufficient lime or calcium carbonate will be added to the surface layer to raise the pH of the soil to between 7 and 8. The lime or calcium carbonate will be spread and incorporated evenly into the top surface of the topsoil layer using conventional farming equipment. Soil conditions will be re-tested and additional applications made to neutralize the soil pH, as required.

16. ***Volume IIC, Section 4.7.5.1, Page 4-29.*** *AST states that planting shrubs along side roads and Rights of Way to create a "buffer" for wildlife might be a suitable method to reduce vehicle caused mortality and facilitate deer movement. It has been suggested that planting cover along road ways actually attracts wildlife to the roadway and may increase wildlife mortality.*

    a) *Discuss how an appropriate mitigation measure for increased wildlife-vehicle collisions will be assessed and selected prior to implementation to ensure it is a suitable and effective method for the region.*

    A. There is a high density of roadways in the LSA relative to an undisturbed landscape. Wildlife, especially deer, is forced to cross these roads on a regular basis. Planting suitable cover near side roads will encourage wildlife such as deer to cross where traffic levels are much lower, reducing the risk of collision. Although the text reads "Plant additional shrubs in adjacent linear features such as side roads", the intention is to plant cover no closer than 100 m from the roadway to ensure adequate visibility along these roadways, which in turn will reduce the chance of collisions.

1.2.5 Biodiversity and Fragmentation

17. ***Volume IIC, Section 5.4.5.2, Table 5.4-5, Page 5-15.*** *The number of unique species in the Native Prairie category in this table and the resulting unique species index does not seem consistent with annual crop, perennial forage crop, and rough pasture. Native prairie is generally known to support much higher diversity and unique species than land converted for agricultural purposes.*

    a) *Discuss possible explanations for the low diversity rating for the Native Prairie category in Table 5.4-5.*

    A. For the purpose of the analysis, unique species are those that are potentially found in three or fewer land units. With the exception of grassland bird species and several rodent species, many prairie species will utilize a variety of habitats. Native prairie is higher quality habitat for most grassland wildlife species than the annual crop, perennial crop and rough pasture. However, most of these species will still utilize these anthropogenic land units to some degree. The analysis does not distinguish between a species preference for higher quality habitat, rather it outlines land units that these species could potentially utilize.

18. ***Volume IIC, Section 5, Appendix II, Table II-1, Pages 5-1 to 5-25 and II-2.*** *The introductory paragraphs indicate that the table provides habitat associations essential for breeding and*

producing young. The latter presumably includes habitat suitable for foraging. Prairie hawk species, notably Red-Tailed and Swainson's Hawks, are known to forage successfully over a variety of agricultural and native prairie land cover types, however this is not reflected in the table since most of the raptor species listed are not included in the land unit associations described for the LSA and Regional Study Area (RSA).

a) *Provide evidence (i.e., peer reviewed literature or further explanation of the assumptions used to develop the table) to support the habitat associations described for raptor species, particularly for the two hawk species mentioned above.*

A. The omission of these species from the table is an error. Both the red-tailed hawk and Swainson's hawk will nest in small stands of aspen and forage in open country habitats. These habitats are found in the LSA. Habitat is not available for the other raptor species, as noted in Volume IIC, Section 5, Appendix II.

1.3 WATER

1.3.1 Groundwater

It is noted that the Lamont County Water Utility has agreed to provide make-up water supply to the Project and therefore groundwater is not required to provide this makeup water. Accordingly, many of the SIRs in this section may no longer be relevant to the Project review. Answers to all of these questions have been provided in any event.

19. ***Worley Parsons Komex 24 Hour Pumping Test October 30, 2007****. AST's consultant states that drawdown of groundwater levels was observed in monitoring wells in the vicinity of the pumping well within a radius of 120 m and no drawdown was observed in monitoring wells located beyond that distance. The nearest observation wells to pumping well 05-01B appears to be monitoring well 05-09A completed in sand overlying bedrock and monitoring well 05-09B, completed in bedrock shale. A third observation well, well 05-02, is also located near the pumping well but appears to be farther away than the 05-09 wells (Figure 2.4-2). Monitoring well 05-02 is completed across what appears to be the same sandstone unit that is being pumped in well 05-01B.*

    a) *Confirm in which observation wells drawdown was observed during the pumping test.*

    b) *If drawdown was observed in the 05-09 monitoring wells, explain the implications this would have on hydraulic connection between the sandstone aquifer and the overlying drift sediments.*

    c) *If drawdown occurred in monitoring well 05-02, explain why this was not used to confirm the aquifer storativity when determining the distance/drawdown relationships given in Figure 2.6-1.*

    A. During the 24 hour pumping test, groundwater levels were recorded at the following monitoring wells: 05-01C, 05-06B, 05-09A, 05-09B and 05-10B. No drawdown was observed in any of these monitoring wells (i.e., groundwater levels at these locations did not vary in response to pumping at well 05-01B).

B. No drawdown was observed in the 05-09 monitoring wells. Therefore, no conclusion can be drawn regarding the hydraulic connection between the sandstone aquifer and the overlying drift sediments.

C. No drawdown was observed in the 05-02 monitoring well. Therefore, aquifer storativity cannot be calculated using the data generated at this location.

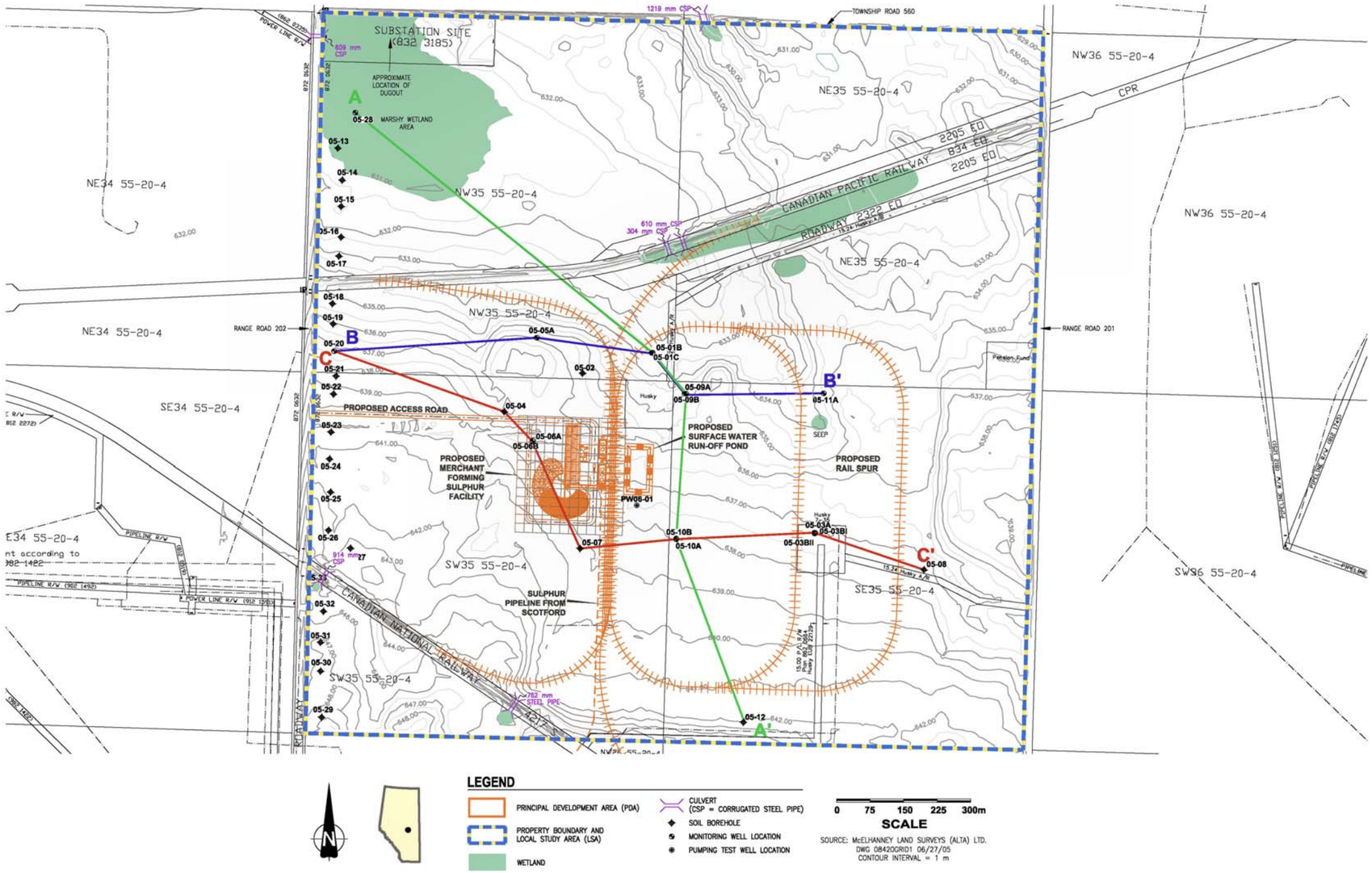


Figure 2.4-2: Existing Monitoring Network and Cross Sections

20. ***Volume I, Section 3.2.5, Page 68.*** *AST states, "the initial sulphur load-out and transfer tank will consist of an in-ground concrete tank surrounded by a permeable leak detection system and secondary compacted clay soil liner".*

    a) *Provide the details of the leak detection system.*

    b) *Provide evidence that there is clay available that is suitable for a liner.*

    A. Conceptually, the leak detection system will comprise a permeable gravel layer surrounding the concrete tank, which is in turn surrounded by a compacted clay soil barrier layer. A slotted observation well will be connected to the drainage layer component of the leak detection system. Both the permeable layer and the surrounding barrier layer will be constructed to completely surround and underlay the tank.

    B. The Site investigation completed in support of the initial hydrogeological investigation confirmed the presence of clay that can be compacted to achieve a hydraulic conductivity less than 10^{-7} cm/sec as measured in the laboratory using the falling head permeability test. Alternately, suitable clay soils can imported for this element of construction.

21. ***Volume IIB, Executive Summary, Section 2, Page 1-ii****. AST states, "Due to the weathered and fractured nature of the upper shale portion of the bedrock, the overburden groundwater appears to be somewhat hydraulically connected to groundwater in the upper sandstone interval".*

    a) *Discuss the potential for groundwater quality impacts from acid deposition to the above noted hydrostratigraphic unit.*

    A. The potential for groundwater quality impacts from acid deposition to the upper sandstone interval would be limited to areas with downward hydraulic gradients (groundwater recharge areas). This potential would be minimal or absent in areas with neutral or upward hydraulic gradients. Vertical hydraulic gradients calculated in Volume IIB, Section 2.5.4.3 of the EIA showed very low upward (05–03), near-neutral (05–06 in November 2005 and June 2006; 05–09) and very low downward gradients (05–06 in June 2005). Any downward migration of groundwater quality impacts from acid deposition in groundwater recharge areas would be slowed by the low-permeability till blanket that is present over most of the PDA. An additional factor limiting the potential for groundwater quality impacts to the upper sandstone interval is the buffering capability of the soils and groundwater, which will resist reduction in pH associated with potential acid deposition (Volume IIB, Section 2.7.1 of EIA).

22. ***Volume IIB, Executive Summary, Section 2, Page 1-ii.*** *AST states "Groundwater flow velocities in the surficial deposits are interpreted to range from several centimetres to several metres per year with an average of about 0.2 m/y".*

    a) *Due to the potential for groundwater discharge from the surficial sand deposit to the wetland and the surrounding surface water bodies, provide an estimate of the maximum groundwater flow velocity in the surficial sands.*

    A. Groundwater velocities in the surficial deposits were assessed in Volume IIB, Section 2.5.4.2 of the EIA and were summarized in Table 2.5-1. The maximum hydraulic conductivity

estimated for the surficial sands was 3.0 x 10^{-6} m/s. Based on this hydraulic conductivity value, the maximum groundwater velocity in the surficial sands is inferred to be 4.8 m/s. This is double the velocity of 2.4 m/s provided in Table 2.5-1, which was based on the estimated mean hydraulic conductivity for the surficial sands.

23. **Volume IIB, Executive Summary, Section 2, Page 1-iii**. AST states, "*Dissolved sulphate appears to be naturally elevated in the portions of the surficial water bearing zone*".

    a) *Provide a map showing the distribution of sulphate in the various sandstone units of the Belly River Formation and the surficial sands in the RSA.*

    b) *Is it possible that elevated sulphate concentration detected in monitoring well 05-20 originates from an off site source? Provide evidence to support your conclusion.*

    c) *To confirm the origin of sulphate in groundwater, will AST consider using isotopes as a tracer? Explain why or why not.*

    A. A map showing the hydrochemistry in bedrock (Belly River Formation) and drift (surficial sands), as reproduced from Stein (1976), is shown in Figure 23-1 with the RSA superimposed. Areas with sulphate constituting over 60% of total anions are indicated on these maps. Groundwater in other areas is either carbonate/bicarbonate dominated (bedrock and till) or chloride dominated (bedrock only).

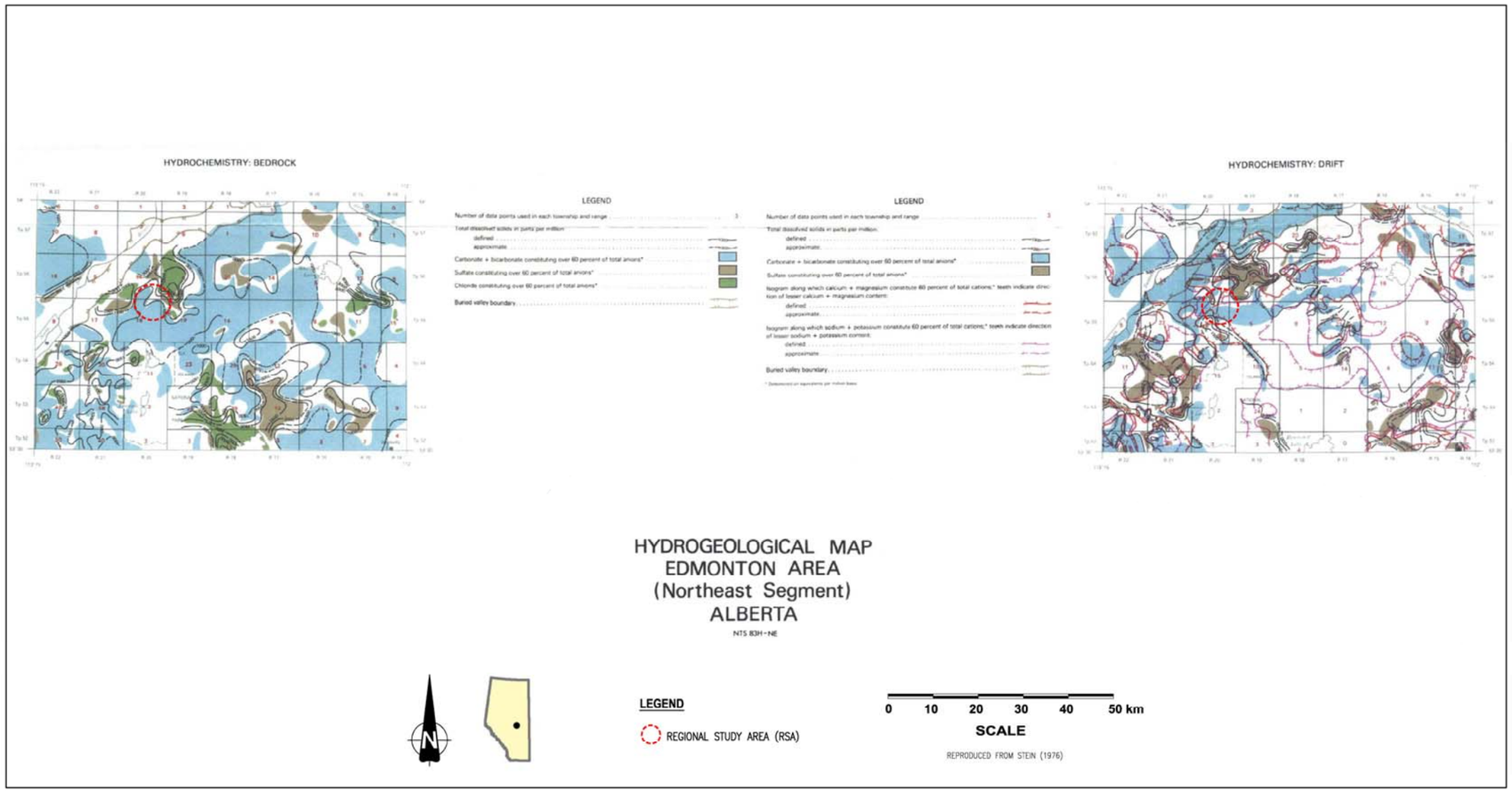


Figure 23-1: Hydrochemistry in Belly River Formation

Elevated dissolved sulphate concentrations were encountered at wells 05–03A, 05–20 and 05–28 (Section 2.5.6.1; Table IV-3). Based on the inferred groundwater flow direction in the surficial deposits (Figure 2.5-7 of the EIA) any off-site source for elevated dissolved sulphate at MW05-20 would have to be located upgradient, to the south-southwest. Two manufacturing plants are located in this general direction:

- Triton Fabrication Services and modular assembly yard on the east side of R.R. 202 south of the Site; and
- Canexus Chemicals on the west side of R.R. 202 adjacent to the CN track.

Inferred groundwater velocities in the surficial deposits are interpreted to be sluggish, ranging from several centimetres to several metres per year with an average of only about 0.2 m/y (Section 2.5.4.2) and a maximum of 4.8 m/y (Question 22). The Canexus facility is located closest to MW05-20, but even then groundwater travel times greater than a hundred years would be predicted. The Triton facility is located ever further upgradient of the Site. It is therefore improbable that the elevated sulphate at MW05-20 is related to either the Canexus facility or the Triton plant. In combination with the evidence regarding regional ambient groundwater quality (Question 23a), AST is confident that the elevated dissolved sulphate is a natural occurrence.

B. There are currently no plans to confirm the origin of sulphate in groundwater through the use of environmental isotopes given the cost and technical difficulty of such an assessment. AST is willing to reconsider this decision, should AENV wish to establish additional evidence regarding the origin of dissolved sulphate at well 05-20.

24. **Volume IIB, Executive Summary, Section 2, Page 1-iii.** AST states, "*Six registered water wells were identified downgradient of the Project... Of these six wells, five have a listed total depth less than 20 mbgs and are thus potentially completed in the same interval as the surficial and upper bedrock aquifers identified at the PDA*".

a) *Complete a field-verified survey of local well owners within a 1.6 km radius to obtain information on current well use, current water levels, and locations of wells not recorded in the AENV database, including the depth of pump intakes.*

b) *Provide a map with the locations of the listed wells.*

c) *Evaluate the available head in local water wells and present the information in a table or on an appropriately scaled map.*

d) *Provide baseline groundwater quality information for the above noted six registered water wells identified downgradient of the Project.*

e) *Based on the long term pumping test, provide quantitative and qualitative assessment of impacts from water withdrawal and the potential for contamination of the six domestic wells located downgradient of the Project.*

AST has approached area residents regarding field sampling pertaining to this EIA and typically has not been granted access. A field-verified water well user survey was not

completed due to the level of opposition to the AST Project. AST would be happy to include all neighbouring domestic supply wells in the monitoring program for the Project, subject to those residents agreeing to allow access. The longer term pumping test was completed to determine the potential for water quantity impacts to off-site groundwater users and is reported under separate cover.

25. ***Volume IIB, Executive Summary, Section 2, Page 1-iii.*** *AST states, "Assuming that an adequate groundwater supply can be proven on Site, it is anticipated that local groundwater levels and flows within the upper sandstone interval will be significantly affected by water withdrawals associated with the Project".*

    a) *Provide additional information regarding the feasibility and sustainability studies undertaken by AST to prove that long term water supplies for the project are adequate.*

    b) *Provide information pertinent to establishing that the Belly River sandstone is capable of providing groundwater of sufficient quantity and quality for the projected life of the Project. Include all relevant maps, borehole logs, and calculation or simulation details.*

    c) *What drawdown is expected at the nearest neighbouring users after 20 years of Project operation, and how long it will take the well to fully recover?*

    d) *Describe initiatives or cooperative industrial efforts in the area to evaluate the groundwater water supply potential of the RSA.*

    A. A longer term pumping test was completed in June to address these issues. This aspect of the EIA was delayed to accommodate the wishes of a neighbour who was concerned that the test could upset their livestock watering well.

    B. The longer term pumping test is reported under separate cover and this report has been submitted to AENV. The results from the longer term pumping test confirm the results of the 2 hour pumping test completed in support of the EIA. The results further indicate that it may be possible to satisfy some of the makeup water requirements for the facility from this groundwater source, but that it is unlikely that the entire makeup requirement can be achieved from groundwater over the long term. Further groundwater exploration and aquifer testing would be required to identify prospective locations for additional pumping wells, to ascertain the response of the aquifer (confined versus leaky) to pumping from multiple wells over a longer period of several weeks to a month and to assess any drawdown interference. Aquifer performance can be readily monitored and flows adjusted such that there are no significant impacts to off site groundwater users. Make-up water will now be obtained from the Lamont County Water Utility, eliminating the need for groundwater (SIRs 5 & 6).

    C. Long term projections of anticipated drawdown are provided with the results of the long term pumping test.

    D. AST will participate in regional groundwater studies and monitoring programs through its participation in the Northeast Capital Industrial Association. This participation will include sharing of groundwater monitoring information and providing assistance to groundwater

studies that may be initiated in the Region, in areas that may be affected by activities related to the Project.

26. ***Volume IIB, Executive Summary, Section 2, Pages 1-iii to 1-iv.*** *AST states "Groundwater travel times to the downgradient (northern) Site boundary are on the order of hundreds of years, indicating ample response time for specific mitigation measures to be implemented should a surface release occur".*

    a) *How confident is AST in their calculation of the groundwater travel times in the PDA? Describe the potential limitations and assumptions built into the travel time analysis.*

    b) *The accuracy of the predictions made by AST may be improved upon by constructing a numerical groundwater flow model at the point of the development when water level monitoring data has been accumulated. Provide an estimate of maximum groundwater flow velocity in the surficial sand deposit and the upper bedrock aquifer.*

    c) *Use the maximum groundwater flow velocity in the surficial sand deposit and the upper bedrock aquifer and recalculate groundwater travel times in the PDA.*

    d) *Provide horizontal conductivity and vertical hydraulic conductivity data for both hydrostratigraphic units. What are the impacts of changing the values?*

    e) *Discuss vertical and lateral variation in the hydraulic conductivity in both units and their influence on groundwater travel times.*

    f) *What options are available for the mitigation/remediation of the contaminated groundwater if it is detected beneath the site?*

    A. Groundwater velocity (v) and travel time calculations are based on the equation $v = K*i/n_e$, in which K is hydraulic conductivity, i is the lateral hydraulic gradient and n_e is effective porosity. Potential limitations and assumptions include:

    - Representativeness of hydraulic conductivity values estimated from single well response tests (slug tests). This limitation was overcome by conducting pumping tests whereby aquifer parameters are determined over larger aquifer volumes (e.g., Freeze and Cherry, 1979). Pumping tests conducted at MW05-01B confirm the hydraulic conductivity values estimated from the single well response tests.
    - Representativeness of estimated lateral hydraulic gradients. The number of monitoring wells completed on site is sufficient to provide accurate information on groundwater levels and lateral hydraulic gradients.
    - Assumptions regarding interconnectivity of relatively low conductivity and relatively high conductivity portions of the water bearing zones. This limitation was overcome by considering a range of hydraulic conductivity values in the groundwater travel time calculations (Tables 2.5-1 and 2.5-2 in the EIA).
    - Limited knowledge of effective porosity. This issue was addressed by selecting a relatively conservative (low) value for effective porosity ($n_e = 0.1$) leading to comparatively short groundwater travel times.

Based on the above assessments, AST is confident that their calculation of groundwater travel times in the PDA are accurate and, in regards to porosity, conservative.

B. AST's consultant respectfully disagrees with the notion that the accuracy of the predictions may be improved upon by constructing a numerical groundwater flow model. Groundwater velocities in a numerical model cannot be determined based on water level monitoring data alone (e.g., Anderson and Woessner, 1992).

The maximum groundwater velocity in the surficial sand deposit was estimated under Question 22 to be 4.8 m/s. The maximum hydraulic conductivity measured for the upper bedrock aquifer was 6.6×10^{-6} m/s (Volume IIB, Section 2.5.4.3; Table 2.5-2). Based on this hydraulic conductivity value, the maximum groundwater velocity in the upper bedrock aquifer is estimated to be 7.3 m/s. This is 3.7 times the velocity estimate of 2.0 m/s provided in Table 2.5-2, which was based on the estimated mean hydraulic conductivity for sandstone.

C. Based on the maximum groundwater velocity for the surficial sand deposit (4.8 m/s), the corresponding minimum groundwater travel time to the downgradient (northern) Site boundary (1 km distance) would be 208 years.

Based on the maximum groundwater velocity for the upper bedrock aquifer (7.3 m/s), the corresponding minimum groundwater travel time to the downgradient (northern) Site boundary would be 128 years.

In heterogeneous (layered) formations, effective horizontal conductivity will tend to converge to the arithmetic average of the hydraulic conductivity variations while vertical hydraulic conductivity will tend to converge to the harmonic mean of these variations (Freeze and Cherry, 1979). These calculations were applied to the combined hydraulic conductivity data for the surficial sand and the upper bedrock aquifer (Volume IIB, Section 2, Appendix IV: Table IV-1). The resulting effective horizontal conductivity for both hydrostratigraphic units is 1.4×10^{-6} m/s and the effective vertical hydraulic conductivity is 3.5×10^{-8} m/s.

The effective horizontal conductivity of 1.4×10^{-6} m/s is within the range of hydraulic conductivities for the surficial sand and the upper bedrock aquifer (1.7×10^{-8} m/s to 6.6×10^{-6} m/s; Tables 2.5-1 and 2.5-2, respectively). As such, there is no impact on the range of groundwater travel times provided in the EIA and Question 26c.

The effective vertical hydraulic conductivity suggests that any downward contaminant migration to the upper sandstone interval would be relatively slow. This is consistent with the discussion provided under Question 21a.

D. Variations in hydraulic conductivity in the surficial sand and the upper bedrock aquifer were discussed in Volume IIB, Sections 2.5.4.2 and 2.5.4.3, respectively, and are summarized in the tables below:

Table 2.5-1: Summary of Surficial Deposits Characteristics

Lithology	Min. K (m/s)	Max. K (m/s)	Mean K (m/s)
Till	2.3E-8	4.2E-8	3.1E-8
Silty Sand	8.0E-7	3.0E-6	1.5E-6

Table 2.5-2: Summary of Upper Bedrock Sandstone Aquifer Characteristics

Lithology	Min. K (m/s)	Max. K (m/s)	Mean K (m/s)
Shale	1.7E-8	3.9E-7	7.7E-8
Sandstone	2.1E-7	6.6E-6	1.8E-6

Hydraulic conductivity testing of the surficial deposits wells showed two orders of magnitude difference between monitoring wells screened within predominantly clay soils and predominantly silty sand or sand. Hydraulic conductivity testing of the bedrock wells showed two orders of magnitude difference between monitoring wells screened within the shale and the sandstone. As a result of these hydraulic conductivity variations, groundwater velocities may vary from several centimetres per year to several metres per year, while groundwater travel times across the Site may vary from hundred years to several thousands of years, depending on the interconnectedness of zones of relatively high and relatively low hydraulic conductivity.

E. Specific management measures could include monitored natural attenuation, risk assessment and/or active remediation. Possible natural attenuation mechanisms for contaminated groundwater include combination of sulphate ions with the abundantly present calcium to form gypsum, which precipitates out of formation, mechanical dispersion and molecular diffusion. Sulphate can also act an oxygen donor in anaerobic biodegradation processes. Remediation measures could include soil excavation, groundwater pump-and-treat or passive groundwater interception through trenches. Groundwater travel times to the downgradient (northern) Site boundary on the order of hundreds of years indicate ample time for mitigation or remediation measures to be implemented.

27. ***Volume IIB, Executive Summary, Section 3, Page 1-v.*** *AST states "Groundwater pumping test analyses indicate that Project water withdrawals may lead to the cessation of groundwater inflows to the wetland area in the northwestern quarter section of the PDA".*

    a) *Based on the long term pumping test data, provide the volume of water lost due to water withdrawal for the Project.*

    b) *Based on the long term pumping test data, verify AST's predictions of drawdown and the corresponding effect to the wetland.*

    c) *Due to groundwater inflows to the wetland from the Project area, there is a high potential for contaminants released at the plant site to discharge to the wetland. Discuss preventive measures to be implemented to preclude this from happening.*

A. The estimated baseline groundwater inflow to the wetland that would have been lost due to water withdrawal (pumping) is 50 m^3/y (Table 2.5-4). This groundwater contribution to the wetland represents less than 0.5% of total annual inputs (runoff, precipitation), which are on the order of 80,000 m^3 (Volume IIB, Section 2.5.7). Thus, the effect of pumping on the water balance of the wetland is very small (Volume IIB, Section 2.6.4).

B. The long term pumping test data (Worley Parsons Komex 24 Hour Pumping Test October 30, 2007) confirmed the results of the 2 hour pumping test completed in support of the EIA. Thus, the EIA predictions of drawdown and the corresponding effect to the wetland remain valid. These predictions were based on the presumption that the entire makeup supply for the Project would be derived from groundwater wells on site (Volume IIB, Section 2.6.2 of EIA), which is no longer the case.

C. Groundwater travel times from the PDA to the wetland were determined to be on the order of hundreds of years or more (Volume IIB, Sections 2.7.1 and 2.7.2 of the EIA). This indicates that ample response time exists for specific mitigation measures to be implemented should a groundwater quality impact occur. Therefore, the potential for contaminants of concern associated with the Project to discharge to the wetland through a groundwater pathway is minimal.

   Measures will be taken to minimize the risk of releases of substances that could otherwise affect water quality. These measures will include, but will not necessarily be limited to, the following:

   - implementing safe construction and operational work procedures to reduce the potential for accidental spillages/collisions/emissions on site during the construction and operational phase;
   - developing an Emergency Response Plan to establish response procedures for potential accidental/catastrophic events;
   - storing and handling potentially hazardous materials in accordance with provincial requirements;
   - implementing sound management practices to minimize generation of fugitive dust;
   - collecting runoff from the sulphur forming and storage areas in a perimeter ditch lined with high density polyethylene (HDPE) that feeds into the surface water runoff pond;
   - ensuring the capacity of the surface water runoff pond exceeds the volume of runoff generated by the 1 in 25 years, 24 hour rainfall event to prevent accidental release/breakthrough;
   - ensuring the pond is double-lined (60 mL HDPE liner over compacted clay soil) and includes a leak detection system;
   - recycling and reusing runoff collection water where possible to minimize or eliminate the need for controlled releases from the pond;

- neutralizing, monitoring, sampling and testing the runoff collection water prior to release, when a controlled release is required;
- ensuring the initial sulphur load-out and transfer tank is an in-ground concrete tank surrounded by a permeable leak detection system and secondary compacted clay soil liner;
- implementing liquid sulphur storage tanks including leak detection systems; and
- constructing an asphalt storage pad for sulphur pastilles including primary asphalt containment, a secondary clay soil liner, runoff and run-on controls and a leak detection system.

28. ***Volume IIB, Executive Summary, Section 2, Page 1-iii; Section 2.5.7, Page 2-31.*** *AST states, "The upper bedrock zone is not in direct connection to nearby surface waters and wetlands, which are protected from the effects of water withdrawals by the overlying till".*

a) *Provide the rationale for AST's assumption that there is a low permeability material present taking into consideration the lack of available lithologs for this area. How does AST intent to address this data gap?*

b) *Provide additional information including geological cross-sections of the overlying till that would verify the above assertion.*

c) *Provide a hydrogeological cross section to demonstrate that the upper bedrock aquifer maintains a confined status across the study area.*

A. Monitoring well MW05-28 is located within the area indicated as "marshy wetland" (Volume IIB, Figure 2.4-2 of the EIA). The borehole log for this well (EIA Volume IIB, Section 2, Appendix III) indicated top soil from 0-0.3 m below ground surface (mbgs), sandy silt from 0.3-0.6 mbgs, clay from 0.6-1.8 mbgs, clay till from 1.8 to 3.0 mbgs and sand from 3.0 to 4.5 mbgs (end of hole). This borehole log therefore provides directly applicable geologic information for the wetland area, which confirm the local presence of a low-permeability clay and till with a thickness of about 2.4 m.

There are no plans to collect additional geologic data in the wetland area so as not to disturb this area.

B. Cross-section A-A' (Volume IIB, Figure 2.5-3 in the EIA) represents a north-south transect across the PDA that includes the wetland area and the above-mentioned well MW05-28. Geologic logs for soil boreholes along the Site west perimeter (Komex, 2006)) also suggest continuity of the (silty) clay and clay till between the wetland and the PDA with a gradual southward increase in total thickness of these low-permeability materials to about 5 m at the PDA (MW05-20). The borehole logs from Komex (2006) are included herein as Attachment 3.

C. Three hydrogeological cross-sections were provided in the EIA (Volume IIB, Figures 2.5-3 to 2.5-5). These cross-sections provide evidence that the upper bedrock aquifer maintains a confined status across the western and northern portion of the Site. Geologic logs for soil boreholes along the Site west perimeter (Komex, 2006) also suggest continuity of the confining

clay and till between the wetland and the PDA with a gradual southward increase in total thickness of these low-permeability materials.

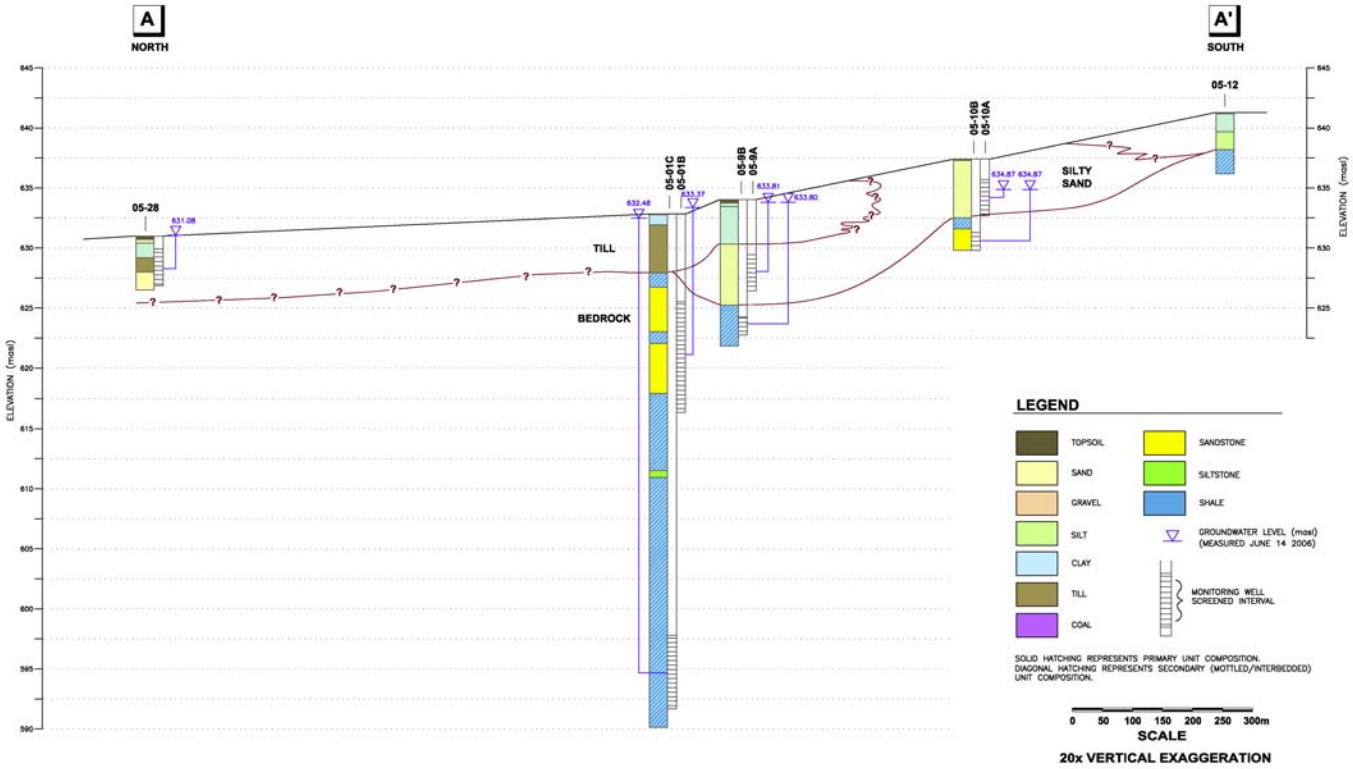


Figure 2.5-3: Cross-section A-A

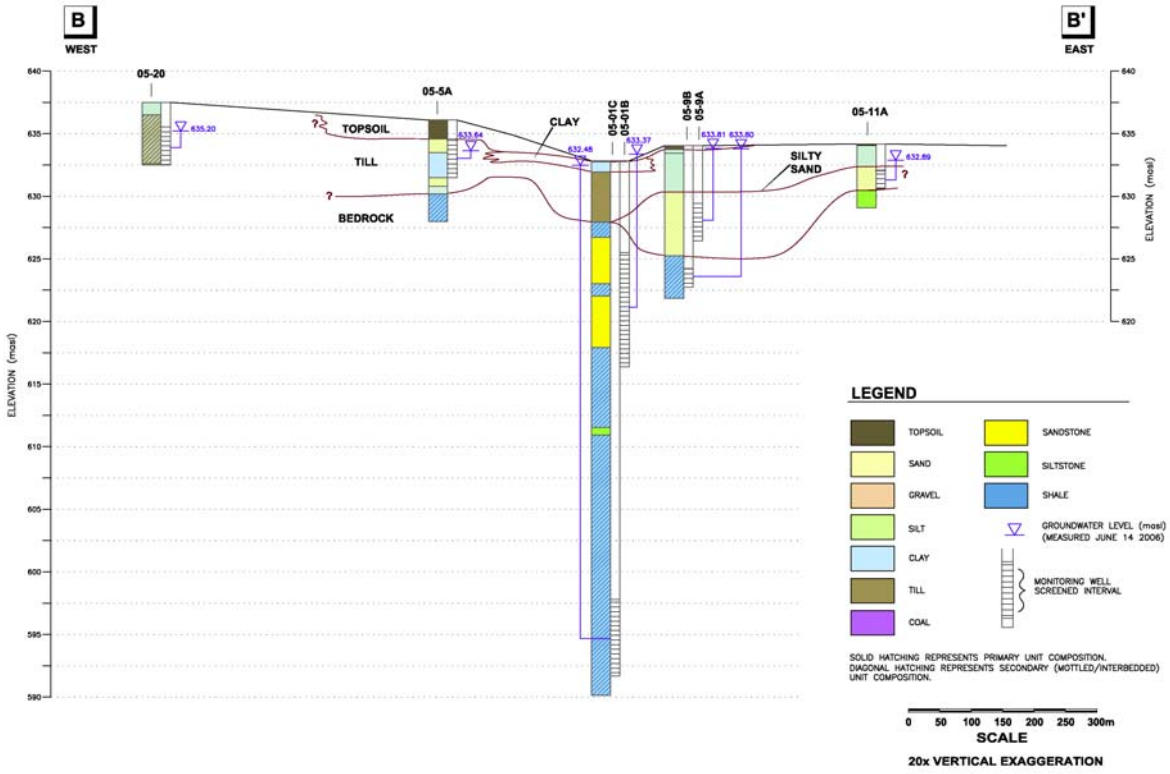


Figure 2.5-4: Cross-section B-B

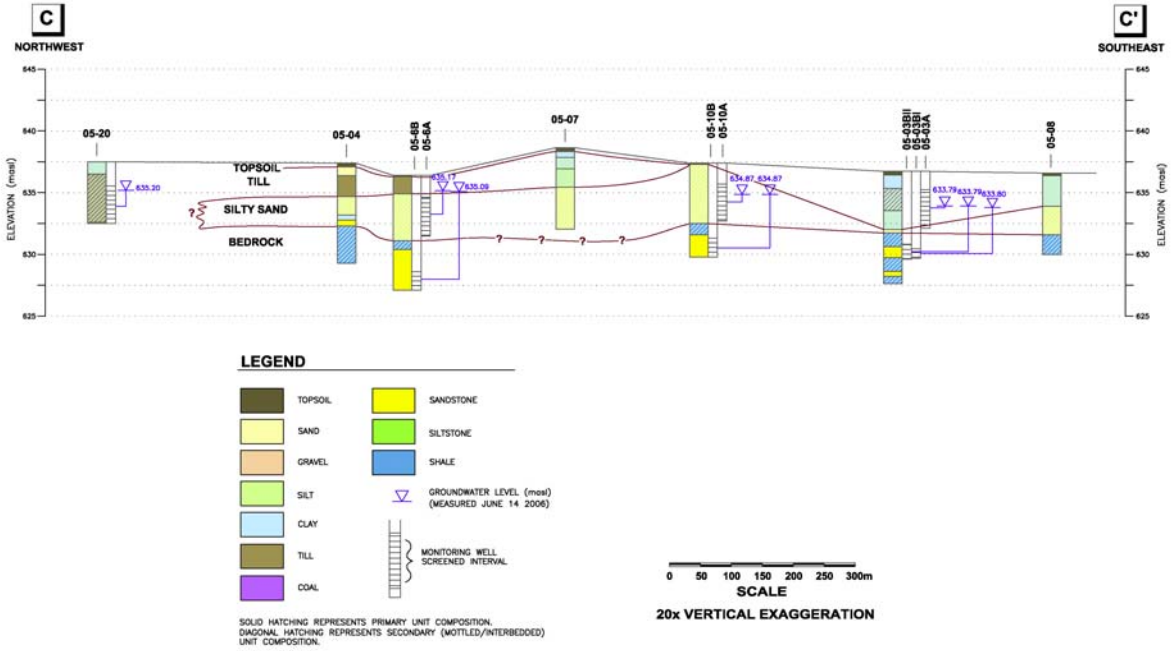


Figure 2.5-5: Cross-section C-C

29. **Volume IIB, Executive Summary, Section 3, Page 1-vi; Section 2.7.2, Page 2-42.** AST states "*the time required for groundwater to travel from the PDA to the northern property boundary is between 100 and 1,000 years, which is effectively the closest discharge, point (wetland).*" *The travel time of groundwater to the Belly River outcrop under natural conditions is predicted to be approximately 1,000 years, assuming a horizontal hydraulic conductivity of 6 * 10^{-9} m/s, an effective porosity for moderately consolidated sandstone of 10% and a travel distance of 600m.*

    a) *Substantiate the selection of these parameters by utilizing existing geophysical logs and long term pump test results from the study area. Discuss variations in horizontal conductivity in the Belly River sandstone.*

    A. It is unclear to AST where the reference to a hydraulic conductivity of 6 x 10^{-9} m/s originates. Groundwater travel time calculations in the EIA were not based on this value. Instead, travel time calculations were based on the following hydraulic conductivity and groundwater velocity characteristics of the upper bedrock sandstone aquifer, as summarized in Volume IIB, Section 2.5.4.3 and Table 2.5-2:

Table 2.5-2: Summary of Upper Bedrock Sandstone Aquifer Characteristics

Lithology	Min. K (m/s)	Max. K (m/s)	Mean K (m/s)	Groundwater Velocity (m/y)
Shale	1.7E-8	3.9E-7	7.7E-8	0.17
Sandstone	2.1E-7	6.6E-6	1.8E-6	2.0
Geometric Mean				**0.58**

The range in estimated groundwater velocities was 0.17 m/y to 2.0 m/y with a median value of 0.58 m/y. Based on a 600 m travel distance these groundwater velocities suggest travel times between about 300 years and 3,500 years with a best estimate in the order of 1,000 years (Volume IIB, Section 2.7.2 of the EIA).

The long term pumping test (Worley Parsons Komex 24 Hour Pumping Test October 30, 2007) indicated an aquifer transmissivity of 4 m^2/day. This corresponds to a hydraulic conductivity of 5.9 x 10^{-6} m/s based on an aquifer thickness of 7.8 m at well 05-01B. The corresponding groundwater velocity would be 6.6 m/y and the travel time, based on a 600 m distance to the northern property boundary, would be about 90 years. This pumping test derived travel time estimate does not take variations in horizontal conductivity in the Belly River sandstone into account (i.e., the presence of lower permeability shale interbeds in the sandstone is ignored).

30. ***Volume IIB, Section 1.1.2.1, Page 1-4****. AST states, "upon arrival, the liquid sulphur is unloaded via a pumping station into insulated and heated receiving tanks."*

    a) *Comment on this area's susceptibility to contamination.*

    b) *Provide a table listing all of the potential sources of contamination for this area.*

    c) *Comment on any mitigation plans AST has considered to help reduce or eliminate the contamination of this area of the plant site.*

d) *Provide the baseline groundwater quality data for the area.*

A. The area's susceptibility to contamination is assessed in Volume IIB, Section 2.7. The general conclusions of this assessment are paraphrased as follows. 'Assuming that all mitigation measures are implemented appropriately and given the buffering capability and low sensitivity of soil and groundwater on site to acid deposition, it is anticipated that groundwater quality within the PDA and LSA will not be measurably affected by acid deposition arising out of normal operational activities.' The area has low susceptibility to groundwater contamination because of its natural buffering qualities and the low rates of groundwater flow.

B. Potential sources of groundwater contamination include sulphur, which can be biologically oxidized to form sulphate, as well as the dust suppression products listed in Volume I of the EIA. No fuel or other chemicals will be stored on the Site. Accidental spills of an unknown nature could also occur and are discussed in our response to SIR 141.

C. Mitigation plans that are related to groundwater quality are described in Volume IIB, Section 2.7.3 and are reiterated below for convenience. 'Measures will be taken to minimize the risk of releases of substances that could otherwise affect water quality. These measures will include, but will not necessarily be limited to, the following:

- implementing safe construction and operational work procedures to reduce the potential for accidental spillages/collisions/emissions on site during the construction and operational phase;
- developing an Emergency Response Plan to establish response procedures for potential accidental/catastrophic events;
- storing and handling potentially hazardous materials in accordance with provincial requirements;
- implementing sound management practices to minimize generation of fugitive dust;
- collecting runoff from the sulphur forming and storage areas in a perimeter ditch lined with high density polyethylene (HDPE) that feeds into the surface water runoff pond;
- ensuring the capacity of the surface water runoff pond exceeds the volume of runoff generated by the 1 in 25 years, 24 hour rainfall event to prevent accidental release/breakthrough;
- ensuring the pond is double-lined (60 mL HDPE liner over compacted clay soil) and includes a leak detection system;
- recycling and reusing runoff collection water where possible to minimize requirements for controlled releases from the pond;
- neutralizing, monitoring, sampling and testing the runoff collection water prior to release, when a controlled release is required;

- ensuring the initial sulphur load-out and transfer tank is an in-ground concrete tank surrounded by a permeable leak detection system and secondary compacted clay soil liner;
- implementing liquid sulphur storage tanks including leak detection systems; and
- constructing an asphalt storage pad for sulphur pastilles including primary asphalt containment, a secondary clay soil liner, runoff and run-on controls and a leak detection system'.

D. Groundwater chemistry is described in Volume IIB, Section 2.5.6 of the EIA. A groundwater characterization report was also submitted with the original Application for the facility. Groundwater quality in both the surficial deposits and the upper bedrock monitoring wells is generally the same, and is predominantly of sodium-bicarbonate type. Total Dissolved Solids (TDS), dissolved sulphate, dissolved sodium and/or dissolved manganese concentrations in all or some of the monitoring wells exceeded the Health Canada (2004a) Drinking Water AO Guidelines (Volume IIB, Section 2.5.6-1 and Appendix IV of the EIA).

31. ***Volume IIB, Section 2.4.4, Table 2.4-1, Page 2-6.*** *This table provides a list of Projects that must be included in cumulative effects assessment.*

a) *Explain why the hydrogeology component of the EIA did not include any of the Projects located close to the proposed AST development.*

A. The assessments conducted in the EIA suggest that Project effects on groundwater quantity and quality will largely be limited to the LSA. Therefore, the potential for the Project to affect groundwater quantity or quality at other nearby projects is negligible due to the limited extent of anticipated Project effects. Similarly, existing projects are not believed to have the potential to affect groundwater quantity or quality within the Site boundaries. These inferences are supported by the following evidence:

- Sandstone intervals within the Belly River Formation such as the one characterized at the PDA are discontinuous and cannot be correlated at scales of about a kilometre or larger (Stein, 1976), effectively ruling out interaction between the AST development and existing Projects through a groundwater pathway.
- The two nearest industrial approved facilities are the ERCO Worldwide Bruderheim Facility (NW-34-55-20 W4) and Canexus (SE-34-55-2- W4). These are relatively small industrial developments, with relatively small environmental and land use impacts. The ERCO chlorate plant is in the process of being decommissioned .

As such, AST is confident that the Application Case encompasses all the anticipated effects to groundwater resources associated with the Project.

32. ***Volume IIB, Section 2.5.2.2, Page 2-19.*** *AST states, "The maximum thickness of till or till – like clay of surficial deposits encountered beneath the site was 6.7 m and the average thickness of the surficial deposits was between 4.5 and 5.0 m."*

a) *Provide an isopach map for this surficial deposit. Identify areas where it may be absent and not able to adequately protect the upper bedrock aquifer from potential contamination.*

A. An isopach map for clay and till deposits has been provided as Figure 32-1. The clay and till is thickest (greater than 4 m) to the north and northwest of the proposed facility location. The thickness of clay and till deposits appears to gradually decline northward towards the wetland area. However, at the wetland these deposits are still a minimum of 2.4 m thick (MW05-28). The clay and till deposits vary in thickness from 1.5 m (MW05-06A/B) to 2.0 m (PW06-01) underneath the proposed facility. Clay and till may be absent immediately to the east of the plant site (MW05-10A/B) and locally along the Site west perimeter (BH05-33).

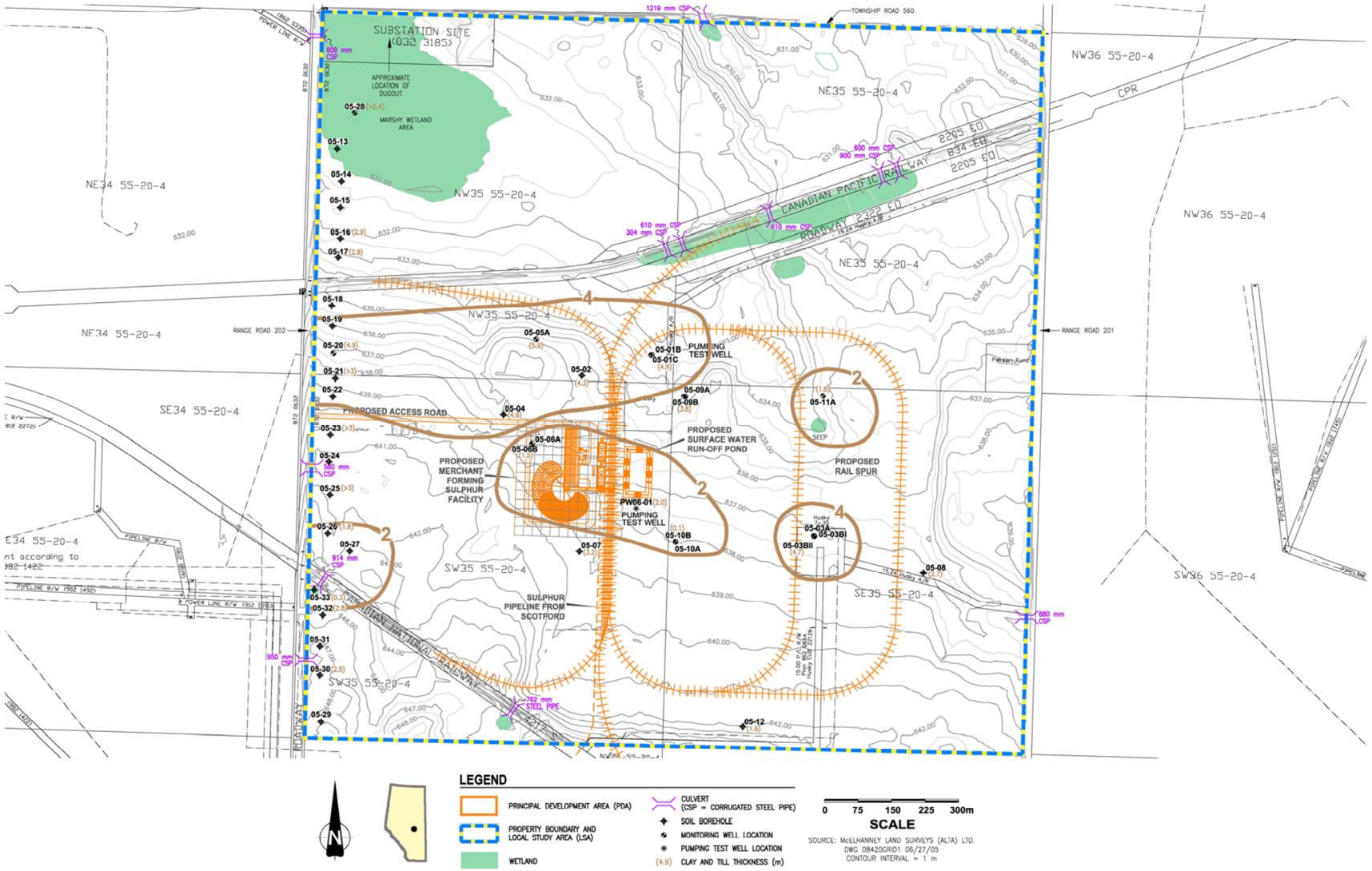


Figure 32-1: Isopach map

33. ***Volume IIB, Section 2.5.2.2 Page 2-19****. AST states "Significant thicknesses of silty sand were encountered in the central and southeast portions of the PDA".*

a) *Provide a map showing the horizontal and vertical extent of the sand unit identified in the PDA and provide its hydrogeological characteristics.*

b) *Can this sand unit be classified as a Domestic Use Aquifer (DUA)? Explain why or why not. If it is classified as a DUA explain what measures AST will take to ensure its protection, both quantitatively and qualitatively.*

c) *Describe the movement of contaminants through this unit and identify potential receptors.*

d) *Confirm that the sand deposit does not extend north of the Project and is not hydraulically connected to domestic water wells located hydraulically downgradient of the Project site. Provide a hydrogeological cross-section to support AST's response.*

A. A map showing the horizontal extent of the silty sand is provided as Figure 33-1. The vertical extent of the silty sand is illustrated on the cross-sections submitted in Volume IIB as Figures 2.5.3 to 2.5.5. The main hydraulic conductivity and groundwater velocity characteristics of the silty sand were summarized in Volume IIB, Section 2.5.4.2 and Table 2.5-1 and are reproduced below.

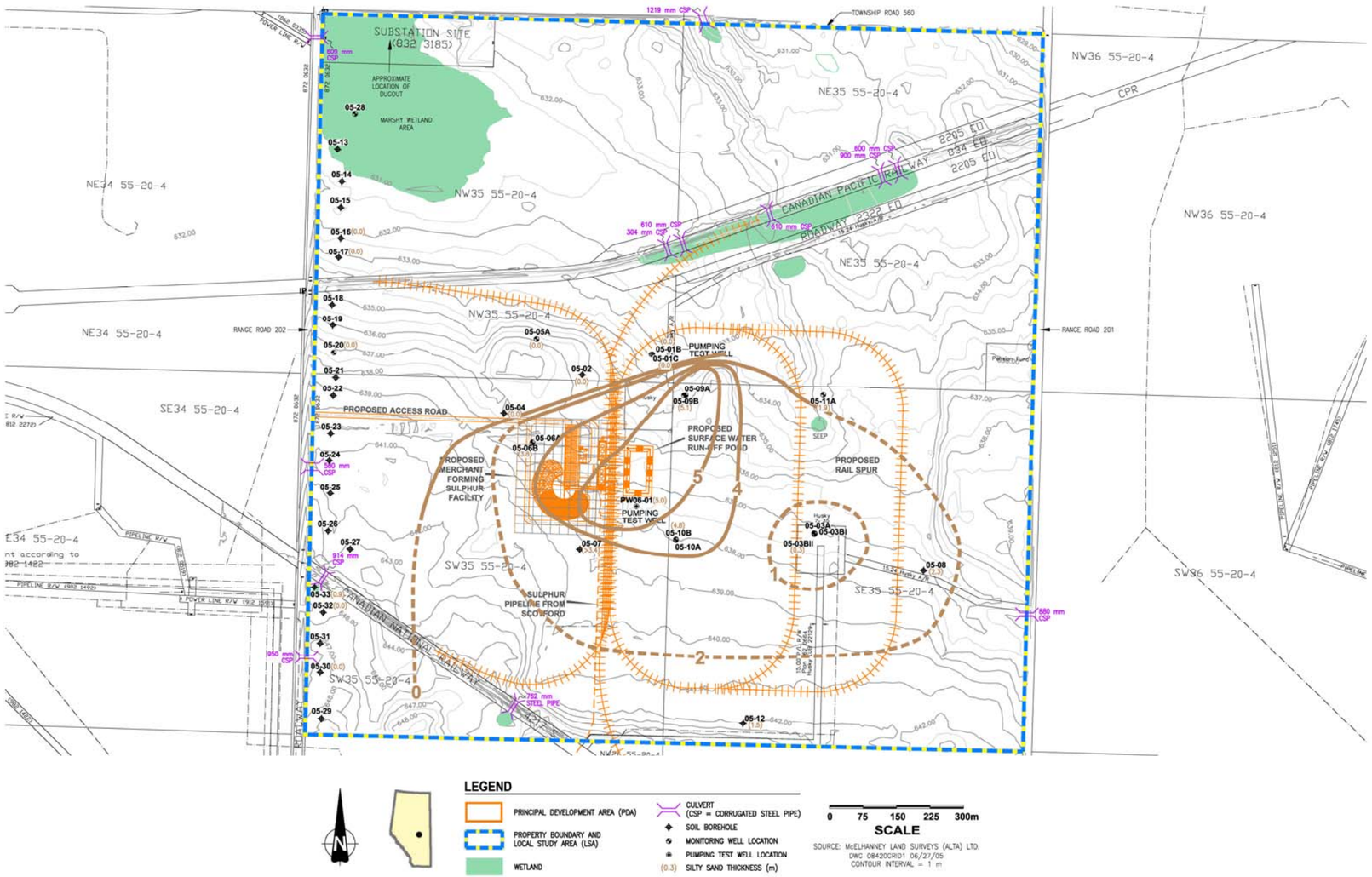


Figure 33-1: Horizontal extent of silty sand

Table 2.5-1: Summary of Surficial Deposits Characteristics

Lithology	Min. K (m/s)	Max. K (m/s)	Mean K (m/s)	Groundwater Velocity (m/yr)
Silty Sand	8.0E-7	3.0E-6	1.5E-6	2.4

B. AENV is currently using the following definition of a DUA: An aquifer capable of a sustainable yield of 0.76L/min, and having one or more of the following properties:

1. the aquifer is currently being used for domestic purposes.

2. the aquifer contains a TDS of 4,000 mg/L or less.

A pumping test has not been conducted in the silty sand unit. Its sustainable yield can therefore not be determined. However, AENV also considers water bearing zones with a hydraulic conductivity of less than 1 x 10^{-6} m/s unlikely to be a DUA. Based on this criterion, the silty sand might be considered a marginal DUA given that its mean K value is 1.5 x 10^{-6} m/s. However, given that the spatial extent of the silty sand appears to be limited to the PDA, it is AST's opinion that it does not merit classification as a Domestic Use Aquifer.

C. Figure 33-1 and the cross-sections submitted in Volume IIB as Figures 2.5-3 and 2.5-4 indicate that the silty sand is discontinuous and pinches out to the north and west of the proposed facility location. Any lateral movement of contaminants within the silty sand would therefore be limited to the PDA. The silty sand is not connected to any potential receptors.

D. Figure 33-1 and cross-sections 2.5-3 and 2.5-4 indicate that the silty sand is discontinuous and pinches out to the north and west of the proposed facility location. Significant thicknesses of silty sand are only encountered at the PDA. Therefore, the silty sand is not hydraulically connected to domestic water wells located downgradient of the Project site.

34. ***Volume IIB, Section 2.5.3 Page 2-19.*** *AST states "Regionally, the bedrock topography dips north across the RSA towards Beaverhill Creek and then northwest towards the North Saskatchewan River".*

a) *Provide a bedrock topography map for the RSA.*

b) *Since the bedrock surface dips towards these surface water bodies comment on the potential for contaminants to discharge into the creek and river. Include a discussion on how AST would address this issue.*

A. A regional bedrock topography map is provided as Figure 34-1.

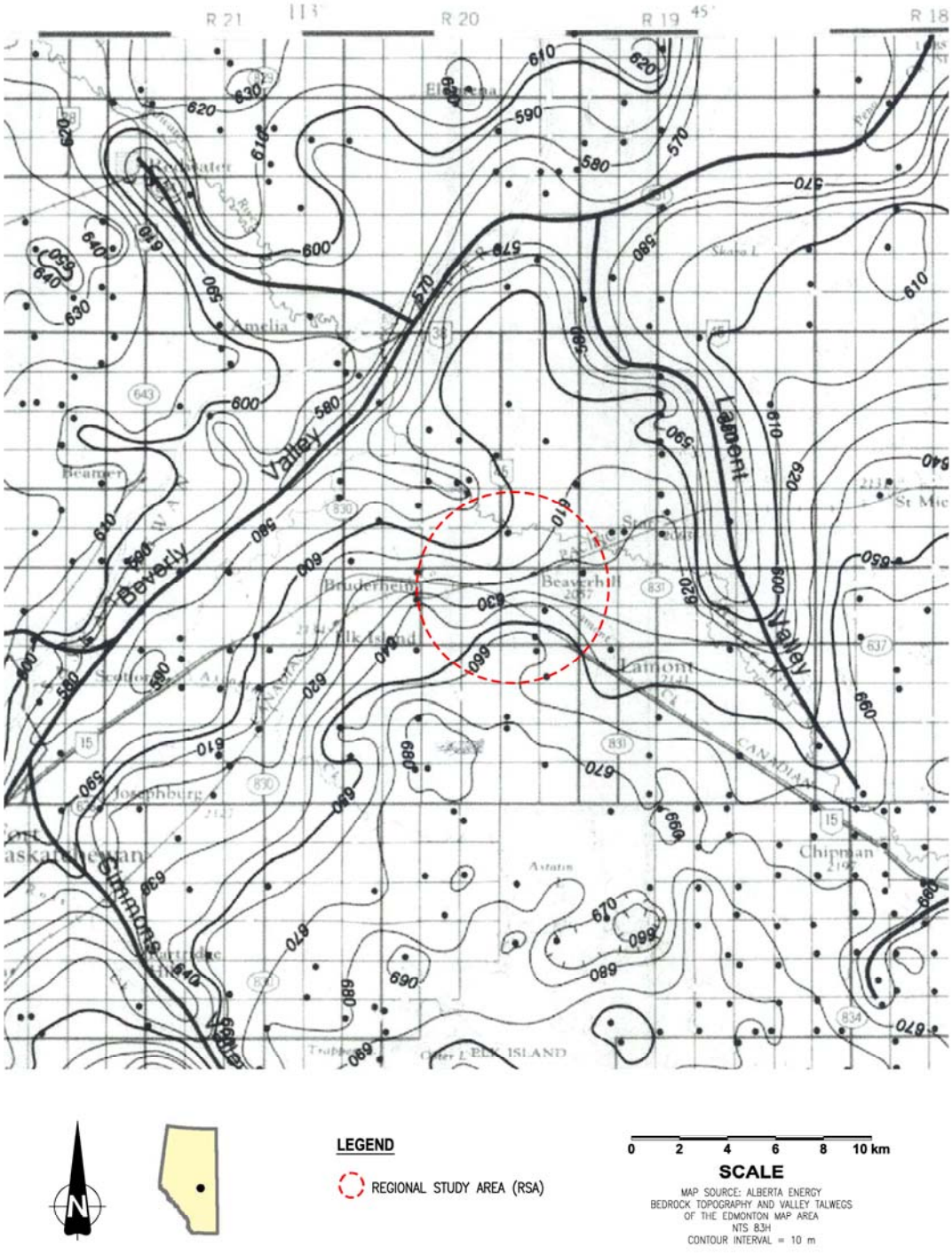


Figure 34-1: Regional bedrock topography map

B. Sandstone intervals within the Belly River Formation generally are discontinuous and cannot be correlated at scales of about a kilometre or larger (Stein, 1976). Thus, while sandstone intervals in the upper bedrock, such as the one characterized at the PDA, may be prevalent regionally, the lateral connectivity of these intervals at scales of about a kilometre or larger is interpreted to be poor due to the presence of shales and siltstones. Consequently, there does not appear to be a potential for contaminants to discharge into the North Saskatchewan River which is located at a distance of 10 km.

The potential for contaminants to discharge to Beaverhill Creek is also very low because even if a hydraulic connection exists, between the Site's northern boundary to the creek, associated groundwater travel times to cross the 1.5 km distance from the PDA to the creek would be on the order of several hundred years or more. This provides ample time for any contaminants to be attenuated through mechanisms such as molecular diffusion, mechanical dispersion and degradation.

Groundwater monitoring at the Project will occur twice-yearly. AST will implement appropriate mitigation measures should a groundwater quality event occur at the Project. These mitigation measures could include monitored natural attenuation and risk assessment (which would take into account the chemical characteristics of contaminants and the abovementioned attenuation mechanisms) or active remediation, should an unacceptable risk be determined.

35. ***Volume IIB, Section 2.5.4.3, Page 2-24.*** *AST says "…the groundwater within the surficial deposits is somewhat hydraulically connected to the upper sandstone aquifer groundwater…the shallow bedrock is weathered or fractured".*

a) *Discuss the potential for local and regional scale cross-formational flow.*

b) *What implications may it have on contaminant transport?*

A. At the regional-scale, cross-formational flow is predominantly between the upper portion of bedrock and the overlying till blanket. This cross-formational flow will overall be relatively sluggish due to the low permeability of the till but may locally be more vigorous in areas where the till is interspersed with higher-permeability sandy materials. An example of such a local area with more vigorous cross-formational flow is the silty sand deposit encountered at the PDA. Such localized areas likely provide focused recharge to the upper bedrock groundwater system.

Groundwater in lower bedrock intervals appears to be hydraulically separated from the upper sandstone intervals by a thick, competent shale unit. As such, cross-formational flow from shallow bedrock units to deeper bedrock units is interpreted to be insignificant.

B. The implications for contaminant transport are that, at the regional scale, sandstone intervals in the upper portion of bedrock such as the one characterized at the Site provide the only pathway for the lateral movement of solutes. Nonetheless, groundwater flow and solute migration within the upper bedrock is slow, on the order of several tens of centimetres to several metres per year.

36. ***Volume IIB, Section 2.6.1, Page 2-32.*** *AST states, "a long term pumping test will be completed to better evaluate the sustainable yield of the upper bedrock unit."*

    a) *Discuss the results of the test conducted, including an assessment of aquifer extent and continuity, transmissivity variations calculated from the test and an interpretation of variations in hydraulic conductivity or aquifer thickness within the cone of depression of the test. Include the calculation of the Storativity coefficient of the aquifer. Discuss the long-term yield of the well (including calculation method).*

    b) *Discuss the drawdown at the location of the nearest domestic wells for the test well, including interference effects from the other existing wells, using similar or tested aquifer parameters from each well location.*

    c) *Long term monitoring of water levels in regional and on site observation wells is a necessary part of a large-scale groundwater diversion project, in order to address potential cumulative effects and describe changes in the hydrogeological flow regime during pumping. Provide a conceptual monitoring program to address this issue.*

    A. The results of the longer term pumping test are discussed under separate cover and address these specific information requirements. The transmissivity of the aquifer was determined to be 4 m^2/day and aquifer storativity was determined to be 0.0012. Because the analysis only incorporated data from the pumping well (water levels did not vary in response to pumping at monitoring wells), aquifer storativity cannot be determined with precision. The long-term yield of the aquifer was estimated using the Farvolden method (AENV, 2003):

    $$Q_{20} = (0.68)(T)(H_a)x0.7$$

    In Farvolden's equation, H_a represents the available drawdown to the top of the aquifer, which was determined to be about 6 mbgs. With a transmissivity of 4 m^2/day, Q_{20} was determined to be about 11.4 m^3/day (8 L/min).

    No aquifer boundaries or variations in transmissivity were encountered within the cone of depression of the 24 hour test, suggesting that long-term aquifer performance is not expected to be significantly better or worse than that established by the pumping test.

    B. No drawdown at off-site wells would be expected during the pumping test because the radius of influence was confirmed to be limited to the on site wells. An offer was made to the closest resident to include their well in the monitoring program; however, their well was not accessible at the time the test was completed.

    C. The proposed monitoring program for groundwater beneath and around the PDA is described in Volume IIB, Section 2.9. The underlying text is extracted from this section. AST would be happy to include all neighbouring domestic supply wells in the monitoring program, subject to those residents agreeing to allow access. It is noted that the rate that water is extracted from these wells is not typically measured; hence, it is typically not possible to correlate the observed water levels in these wells to the Project operations.

'It is proposed that groundwater monitoring wells completed in the surficial deposits and upper bedrock at the PDA (i.e., "A" and "B" series wells; Figure 2.4 2), be monitored twice annually to evaluate potential effects to groundwater quantity (i.e., water levels) and quality. Groundwater samples will be collected using standard methodologies, preservation, containment and transport techniques. It is proposed that the analytical schedule for ongoing monitoring of the sulphur facility include temperature, pH, electrical conductivity and routine potability parameters. The monitoring program will be adaptively managed to ensure that it adequately reflects understanding of the local hydrogeology and possible effects related to the operation of the proposed facility.'

Upon Project approval, the design of the monitoring network and monitoring schedule would be submitted to AENV for review, comment and approval.

A response plan or action plan will be developed to enable prompt courses of action in the event that routine monitoring detects an impact that may eventually become unacceptable.

37. ***Volume IIB, Section 2.6.1, Page 2-33.*** *AST states* ***"…****the potential groundwater response to Project water withdrawals in the upper bedrock sandstone aquifer was calculated allowing for a range of possible scenarios regarding the long term response to pumping."*

    a) *What confidence does AST have in assessing the potential impacts to groundwater resources from the Project water withdrawals, taking into consideration the fact that the hydrogeological baseline conditions of aquifer performance were not established?*

    A. AST has high confidence that impacts to the groundwater resources from the Project withdrawals will be consistent with that predicted by the long term pumping test. This pumping test established reliable baseline conditions regarding aquifer performance. Aquifer performance is not expected to be significantly better or worse than that predicted by the pumping test. Further, impacts to the water levels in this aquifer may be readily and reliably monitored as pumping occurs.

38. ***Volume IIB, Section 2.6.7.1, Page 2-39.*** *AST states, "based on the conducted assessments, significant impacts of Project water withdrawals are not expected at distances greater than 750 m from the supply wells. The overall effect to groundwater levels and flows during the Project lifetime is therefore considered to be negative in direction, regional in extent, negligible to low in magnitude, medium term in duration and reversible."*

    a) *Provide data (i.e. from the long term pumping test) to verify these predictions.*

    b) *Provide information on industrial groundwater users in the RSA.*

    c) *How does AST plan to address an interference of cones of depression if they occur?*

    A. The results from the 24 hour, June 2007 pumping test (reported separately) confirm the results of the 2 hour pumping test completed in support of the EIA. As such, the assessments conducted in the EIA regarding extent, magnitude and duration of impacts from Project water withdrawals remain valid. These assessments were based on the presumption that the entire makeup water supply for the Project would be derived from groundwater wells on site which is no longer the case.

B. Information on industrial water wells within a 1 km radius from the Site was reported in Appendix V of the EIA V. Only one industrial well (LSD 08 26 55 R20 wym) was encountered within this search radius. Two industrial approved facilities exist to the west of the proposed AST Project, ERCO Worldwide Bruderheim Facility (NW-34-55-20 W4) and Canexus (SE-34-55-2- W4). The ERCO chlorate plant is in the process of being decommissioned. It is our understanding that these facilities did not use on site groundwater to supply their operations.

C. Interference of cones of depression is not expected. Further, impacts to the water levels in the upper bedrock sandstone aquifer may be readily and reliably monitored as pumping occurs. AST would halt pumping should drawdown interference with neighbouring industrial or residential wells become apparent.

39. ***Volume IIB, Section 2.7.1, Page 2-41.*** *AST states, "A potential effect to groundwater quality is associated with the deposition of elemental sulphur on soil which then is transformed to sulphuric acid through bacterial oxidation, decreasing soil pH".*

a) *Provide a map with locations of groundwater monitoring wells (including early warning and compliance monitoring wells) around the perimeter of the sulphur forming and storage facilities, as well as unloading areas.*

A. The proposed monitoring program for groundwater beneath and around the PDA is described in Volume IIB, Section 2.9. The text provided below is extracted from this section.

'It is proposed that existing groundwater monitoring wells completed in the surficial deposits and upper bedrock at the PDA (i.e., "A" and "B" series wells; Figure 2.4 2), be monitored twice annually to evaluate potential effects to groundwater quantity (i.e., water levels) and quality. It is proposed that the analytical schedule for ongoing monitoring of the sulphur facility include temperature, pH, electrical conductivity and routine potability parameters. The monitoring program will be adaptively managed to ensure that it adequately reflects understanding of the local hydrogeology and possible effects related to the operation of the proposed facility. Possible amendments could include additional monitoring locations, increased monitoring frequency and/or revised analytical schedule.'

Upon Project approval, the design of the monitoring network and monitoring schedule would be submitted to AENV for review, comment and approval.

40. ***Volume IIB, Section 2.8, Page 2-44.*** *AST states, "…Project effects on groundwater quantity and quality will largely be limited to the LSA. Therefore the potential for the Project to affect groundwater quality and quantity at other nearby projects is negligible due to the limited extent of anticipated Project effects" Two industrial approved facilities exist to the west of the proposed AST Project, ERCO Worldwide Bruderheim Facility (NW-34-55-20 W4) and Canexus (SE-34-55-2- W4). These projects may be connected to a groundwater system that could overlap with the Project.*

a) *Discuss the combined effects of the proposed water use by AST and the water use of other water diversions (surface water and groundwater) in the area on the aquatic environment and existing water users.*

A. It is AST's understanding that these industrial operations do not obtain their water from groundwater wells located on their property. Hence, the combined effects to groundwater in the area are limited to those effects predicted for the Project. Cumulative effects of proposed water use by AST and the water use of other water diversions (surface water and groundwater) on the aquatic environment and existing water users are not expected. This opinion is based on the confirmation of the use of the Lamont County Water Utility as the source of make-up water and the results of the EIA assessment that significant impacts of Project water withdrawals are not expected at distances greater than 750 m from the AST supply well(s). The results of the long-term pumping test conducted at the Site in June 2007 confirmed that this EIA assessment remains valid. Predicted impacts to the water levels in the upper bedrock sandstone aquifer may be readily and reliably monitored as pumping occurs.

41. ***No Reference.*** *Involvement in Regional Programs*

a) *Define AST's level of participation in regional groundwater monitoring programs/studies.*

b) *Comment on the capacity of regional groundwater monitoring programs to accommodate groundwater or commitments which may arise from this Project.*

A. As a member of the Northeast Capital Industrial Association, AST will share information gained through execution of its groundwater monitoring program with this partnership. AST will continue to support and participate in regional monitoring programs that are relevant to this Project and vice versa.

B. AST is not aware of any limitations on the capacity of the regional groundwater monitoring programs to accommodate groundwater withdrawal or monitoring commitments that may arise from this Project.

1.3.2 Surface Water

42. ***Volume I, Section 3.2.1, Figure 3.2-2, Page 64.*** *The Process Flow Diagram indicates that cooling water, blowdown and (possibly) boiler blowdown will be routed to the run-off pond. In Section 5.1, AST indicates that cooling water will also be recycled through the run-off pond. The continuous process of returning blowdown water, recycling cooling water and evaporation from the run-off pond could result in a high degree of mineralization in the pond water.*

a) *Estimate the total dissolved solids content of the run-off pond water before it would be released to the north[west] (sic) wetland and, ultimately, Beaverhill Creek.*

b) *Estimate the appropriate chemical composition of the released water.*

c) *Provide information regarding the fate and toxicity of any biofouling and/or corrosion inhibiting products used.*

A. There is no plan to release water that collects in the runoff pond to the northwest wetland and ultimately to Beaverhill Creek. The pond water will be recycled and used as cooling water in the sulphur forming process. Evaporation will occur in this process, causing the mineralization of this water to increase until precipitation of these minerals occurs. Calcium and sulphate will be the dominant ions in this case, and have relatively low solubility. Precipitation of solids is

expected to occur in both the pond (where solids will settle) and the cooling system (where equipment will be cleaned). Discharge of water to the northwest wetland would only occur under extreme conditions when runoff exceeds the capacity of the pond. Significant dilution of the mineralization of the stored water is anticipated under these conditions. Calcium and sulphate are significant ions in the natural surface water and groundwater circulation regimes of the Site; hence, their presence is not expected to upset the water chemistry of the wetland or Beaverhill Creek.

B. There is no rigorous way to calculate water chemistry in this case because discharge would only occur under unplanned, extreme runoff conditions. An estimate of the chemistry of water that may be discharged to the wetland under these conditions can be made by assuming that the water in the pond approaches the solubility of calcium sulphate, and that the pond is ½ full just prior to experiencing the extreme runoff event. Further, it can be assumed that the mineralization of the recent runoff water is approximately ¼ that of the water contained in the pond. Based on these assumptions, the mineralization of the discharged water would be approximately half of the solubility of calcium sulphate. In the absence of other salts and in neutral pH conditions, the solubility of calcium sulphate is typically less than 2,000 mg/L. This solubility can increase in the presence of other dissolved salts.

C. Any bio-fouling or corrosion inhibiting substances would remain in the water collection pond and recycle loop, as there is no plan to discharge this water to the environment.

43. ***Volume I, Section 5.1, Page 93.*** *AST states that, "the capacity of the surface water runoff pond exceeds the volume of runoff generated by the 1 in 25 years, 24 hour rainfall event".*

a) *Has the ditch around the sulphur pastille storage area and the drain to the runoff pond also been designed for this rainfall event? If so, provide the design details. If not, explain why.*

A. Detailed design of the facilities, including the collection ditch, will occur once the Project is approved. Conceptually, the ditch would be constructed to a depth and width capable of conveying the peak runoff generated by the 1 in 25 years, 24 hour runoff event. Given the relatively small area of water collection, this ditch is not expected to be unusually large.

44. **Volume IIB, Section 3.5.4.1, Figure 3.5.4, Pages 3-15 and 3-18.** AST states "*the wetland area in the northwest corner of the site, while containing water during average annual flood conditions, was dried out from mid-August to October, 2006.*".

a) *Confirm whether the pressure transducers were placed in the wetland during August to October 2006 only. If so, why was the surface water monitoring period for the wetland restricted to late summer and fall? If not when else during the year were the pressure transducers placed in the wetland?*

b) *What is known about the wetland's subsoil, specifically, the soil type, bulk density, and hydraulic conductivity?*

c) *Have perched conditions been observed in the wetland, or can surface water readily infiltrate, depending on fluctuations in water table elevations? Explain.*

d) *What general pattern of seasonal fluctuations in groundwater elevations have been demonstrated below the wetland?*

e) *Groundwater contributions to wetland surface water are stated to account for only 0.5% of annual surface water flow. What role does groundwater play in sustaining the presence of surface water in the wetland (through an elevated water table) in this feature on a seasonal basis?*

f) *As stated in Section 3.6.4, the potential response of the upper bedrock aquifer to long-term water withdrawals is subject to some uncertainty. If surface water is sustained in the wetland as a result of a high water table and restricted infiltration potential, how will long-term water withdrawals influence the presence of surface water within the wetland?*

A. The pressure transducers were placed in the wetland from August to October 2006. The surface water monitoring period commenced in August 2006, because equipment was not available prior to this time. Equipment was removed in October 2006, to avoid any potential damage due to freezing temperatures.

B. The characteristics of the wetland soils were determined in the baseline studies in the Soils section of the EIA (Volume IIC, Section 2). The wetland soils were determined to be of the Manatokan AA soil series. The bulk density of the 0-60 cm layer was 440 kg/m^3. Hydraulic conductivity was not determined in the soils analysis. Complete details of the Manatokan soil series are presented in Volume IIC, Section 2, Appendix II.

C-E. It is likely that perched conditions did occur, and that the major contribution to this wetland is precipitation. Given the results of the groundwater quantity assessment observed that there is minimal groundwater input to the wetland, it was determined to be unnecessary to calculate seasonal inputs, or demonstrate the general pattern of seasonal fluctuations in groundwater elevations below the wetlands. This determination was arrived at on the b asis of the professional judgement of AST's consultants.

F. As stated in Volume IIB, Section 2.6.8.1, Project water withdrawals may lead to cessation of groundwater flow. However, since it was estimated that groundwater flow only comprised 0.5 % of the total annual water balance inflow long term impacts are expected to be negligible.

45. ***Volume IIB, Section 3.5.5, Table 3-58, Pages 3-20 and 3-21.*** *A runoff coefficient of 0.06 was assumed for the water balance of the western drainage basin. AST states that this value was obtained from the Prairie Farm Rehabilitation Administration Regional median annual unit runoff estimates.*

a) *Considering the low permeability of shallow soils in the western drainage basin, 4.1 x 10-7 m/s, as stated in Table 3-58, provide the rationale for applying such a low runoff coefficient to an area of low permeability.*

A. Regardless of permeability, in areas where there is low precipitation, high evapotranspiration, and significant soil water storage capacity, there will be relatively low runoff (Devito et al. 2005). As a result, the runoff coefficient selected is considered appropriate in this case.

46. ***Volume IIB, Section 4.6.10, Page 4-34.*** *AST states that aside from potentially acidifying outputs, "the Project is not anticipated to release other deleterious compounds into aquatic ecosystems and, therefore, no cumulative effects are anticipated." However, stormwater management pond releases will contain total suspended solids, and associated nutrients (e.g., total phosphorus).*

    a) *Considering the degraded water quality currently present in Beaverhill Creek, comment on the cumulative effect of introducing greater total suspended solids and nutrient loadings to this already impacted water body.*

    A. There is no plan to discharge surface water from the sulphur handling area; hence, there should be no degradation of surface water quality in the northwest wetland and Beaverhill Creek. A complete assessment of the potential impacts to surface water quality is presented in Volume IIB, Section 3. Discharge from the pond on the Site will only occur (if at all) during extreme runoff conditions when all surface water drainage systems that surround the Site will be flowing very rapidly. There is no reason for nutrients to accumulate in the stormwater pond and the pond will effectively reduce any suspended solids that may otherwise be present. Therefore, elevated nutrients and suspended solids are not anticipated, even under extreme runoff conditions when it may be necessary to release water from the pond. In the very unlikely case that the stormwater management pond released water, TSS concentration would be diluted during a storm event and it would be very unlikely that elevated concentrations would reach Beaverhill Creek.

47. ***Volume IIB, Section 4.7, Page 4-34.*** *AST states that: "discharge limits for specific contaminants (if and when suspected) will be determined in accordance with the Water Quality Based Effluent Limits Procedures Manual (AEP, 1995)" and generic criteria but Section 3.6.6 indicates that "in a flood situation, where runoff exceeds design criteria of the pond, the water will be tested for quality, treated (if required) and released to the environment provided that the water quality meets Surface Water Quality Guidelines for Use in Alberta".*

    a) *Clarify whether it is AST's intention to use two different procedures for release of runoff to the environment. If not, which procedure will AST use and why? If so, explain the rationale for the two different procedures.*

    A. It is not AST's intention to use two different procedures for release of runoff. The "Water Quality Based Effluent Limits Procedures Manual" reports toxicity guidelines and is based on effluent discharge, wasteload allocation modelling, and end-of-pipe water quality based effluent limits. The document "Surface water quality guidelines for use in Alberta" provides general guidance in evaluating surface water quality, to identify areas with existing or potential water quality concerns, and is used in setting water quality based approval limits for wastewater discharges. It is our opinion that the standard parameters used by AENV to monitor the release of neutralized water from the pond are suitable and appropriate for this Project. These parameters are listed in the EIA and discussed further in the response to SIR 50.

    Although two different regulatory documents are referred to, it is appropriate to apply the effluents standards to plant discharge, whereas, in the unlikely event of a flood situation, it is more appropriate to apply direct water quality guidance used in generic surface water

situations. Using two different guidance documents does not imply that two different procedures will be followed, but ensures the most appropriate and stringent standards will be applied.

1.4 Aquatic Ecology

48. ***Volume IIB, Section 4.1.1.2, Page 4-3.*** *AST states, "given that the proposed sulphur forming and shipping facilities are above ground and in an open environment, the possibility of developing anaerobic reducing conditions and H_2S during operational activities is considered to be remote".*

    a) *In an open, aerobic environment, microbially mediated oxidation of elemental sulphur to sulphate can readily occur. The sulphate formed is soluble and can be transported by surface water to the catchment pond, wetland or to groundwater. Within the anaerobic, reducing environments found in the latter settings, heterotrophic sulphate reduction can occur with the production of hydrogen sulphide. Reconcile the apparent difference in perspectives presented.*

    A. The reference to oxidation of elemental sulphur is made in the context of the surface water collection system. This is a lined and contained system, and is aerobic. Hence, it was concluded that sulphate, and not sulphide, would be generated by bacterial oxidation of the sulphur in this environment. This process is observed in all runoff containment systems associated with sulphur storage facilities in the Province. Under anaerobic conditions, sulphate can be reduced by bacteria to form sulphides. In an anaerobic wetland, or in groundwater, the sulphides typically combine with dissolved metals, such as iron, and precipitate out of solution. Anaerobic reduction of sulphate is not expected in this case because the surface water will be contained in lined ditches and the lined storage pond, which are open to the atmosphere and will remain aerobic.

49. ***Volume IIB, Sections 4.6.2 and 4.6.8, Pages 4-26 and 4-33.*** *AST indicates that a possible mitigation option for the treatment of adversely impacted surface water quality is to "divert the impacted runoff to the wetland located in the northwest corner of the property boundary". AST states "the wetland would improve the water quality through the processes of retention, settling, filtration and biodegradation." AST estimates the volumetric capacity of the wetland to be 125,000 m^3 and runoff from the PDA to be 30,000 m^3.*

    a) *Provide available baseline data that characterizes the anticipated treatment capacity of the wetland.*

    b) *Provide a surface water, sediment and aquatic resources monitoring program for the wetland that will be appropriate for its proposed use as a bio-treatment cell.*

    A. The Project is designed to be a no discharge facility. Any water that will be released from the surface water runoff pond will be treated, if necessary, prior to release to the wetland. There is no plan by AST to use the wetland as a bio-treatment cell. In the event that an unplanned release of surface water occurs, which is unlikely given the mitigation measures incorporated into the facility design, the wetland has high alkalinity and it is anticipated that the buffering capacity of the wetland will neutralize any unplanned discharge. The statement cited above on

p. 4.26 is not clear in the text of the document. No impacted water will be intentionally released from the facility into the wetland. All impacted water will be treated prior to release.

B. Wetland monitoring has been included in the monitoring and adaptive management plans for the surface water of the Site. The wetland will not be used as a bio-treatment cell. Therefore, a monitoring program to evaluate the capacity of the wetland to be used as a bio-treatment cell, is not necessary. The monitoring recommended in the EIA for the wetland is included below:

'The following surface water quality monitoring will be performed by Alberta Sulphur Terminals Ltd. (AST) and/or HAZCO Environmental Services (HAZCO) during construction and operation activities to ensure potential impacts are mitigated:

- Best management practices will be employed during construction to minimize impacts to runoff quality.
- Monitoring of surface water quality in the wetland will be conducted at a reasonable frequency, consistent with groundwater monitoring. Water quality will be monitored in the on site wetland before and after groundwater withdrawals commence to assess potential impacts. Grab samples will be collected immediately prior to release of any water to the surrounding environment. Any water that may be discharged from the runoff collection pond will be sampled and tested to comply with the following generic criteria:
  - no visible sheen;
  - 6<pH<9;
  - chemical oxygen demand <50 mg/L;
  - chloride <500 mg/L;
  - TSS <50 mg/L; and
  - discharge limits for specific contaminants (if and when suspected) will be determined in accordance with the Water Quality Based Effluent Limits Procedures Manual (AENV 1995)'.

50. ***Volume IIB, Sections 4.7 and 5.7, Pages 4-34 and 5-18.*** *In order to ensure the protection of aquatic resources AST indicates that surface water that is to be potentially discharged from the Site, will be monitored for a number of standard water quality parameters e.g., visible sheen, pH, chemical oxygen demand, chloride, total suspended solids*

a) *Explain how AST determined what the generic discharge criteria would be.*

b) *Explain AST's rationale for not including water quality monitoring parameters that are considered more specific and related to acidification e.g., electrical conductivity or total dissolved solids, sulphate and total sulphur.*

A. AST proposes to monitor standard water quality parameters associated with sulphur runoff collection and neutralization facilities. Based on our review of existing approvals, monitoring parameters for these facilities are typically consistent with those listed in the referenced sections.

B. The standard discharge monitoring parameters are considered appropriate for the proposed Bruderheim facility because the water quality associated with runoff from this facility will not be different from any other sulphur management facility in the Province, and because these parameters have proven to be reliable in protecting surface water quality and the dependent ecological resources. It is noted that AST plans to collect, contain and reuse this water as part of standard operations. Monitoring water quality and releasing water will only be considered under extreme runoff conditions.

1.5 AIR

51. **Volume Application, Sections 3.5 and 5.10, Page 11; Volume 1, Section 3.5, Pages 69-74.** A cooling tower is proposed for cooling purposes. Provide the following information:

a) *Cooling tower blowdown rate.*

b) *Water quality of the cooling water blowdown.*

c) *How cooling water blowdown will be managed.*

d) *Chemicals that will be used in the cooling tower.*

e) *"The water utilized by the Rotoformer HS process will be sent through a closed loop cooling tower which will provide filtration and temperature reduction." Describe the filtration process.*

f) *Discuss alternate technologies that are available for cooling purposes and provide* [sic] *AST's rationale for choosing a cooling tower instead of other cooling methods.*

g) *What are the impacts of evaporation from the cooling tower operation during winter?*

h) *What is the expected volume of water in the blowdowns?*

i) *Clarify if AST has included this volume in the water usage numbers specified in Section 3.5.1 of Volume 1. If not, update this section accordingly.*

j) *Where will the blowdowns from the cooling tower and boiling operations go?*

k) *The process diagram (Figure 3.2-2) indicates a boiler blowdown tank and blowdown from the cooling tower basin. Provide a description of these processes.*

The functional design and performance specifications for the cooling water system, including the cooling tower, are presented in the Design Basis for the initial development, which is included as Attachment 1. Answers to specific questions are provided below.

A. The blowdown rate is 21 US gpm.

B. The answer to this question is discussed in the response to SIR 42.

C. Blowdown is directed to the stormwater pond.

D. There are no specific chemicals planned for use in the cooling tower. It is possible that lime will be used for pH adjustment. Anti-scaling additives will be required to prevent scaling in pipes, pumps and controls, and a biocide will be required to prevent bio-fouling of the system.

E. Bag particle filters will be used to remove suspended solids from the cooling water loop.

F. A cooling tower was selected as the simplest, most reliable and most effective technology for cooling water for re-use. Alternate technologies were not considered because the cooling tower option is considered proven, reliable technology.

G. The average evaporation rate is 2 US gpm. No significant impacts associated with evaporation are anticipated in winter.

H. As stated in the response to Question A, the expected blowdown rate is 21 US gpm. Blowdown will be directed to the surface water pond, which will contain a minimum of 6,000 m^3.

I. The specified water volumes were included in AST's water consumption estimate.

J. Cooling water blowdown water is directed to the surface water pond. Boiler blowdown is collected in a tank and is legally disposed off site.

K. A description of the process is provided in Attachment 1.

52. ***Volume I, Section 2.3.4, Page 16, Appendix 4, Page IV-41; Volume IIB, Section 5.5.6.2, Page 5-14.*** *AST states "usage rates of dust suppression agents are estimated to be <100 kg/d during initial operations…" The MSDS information included by AST in the EIA identifies the chemical constituents and properties of Dustbind S5. IPAC SRB Plus is described as a proprietary product and MSDS information is lacking.*

a) *Provide any available information regarding the fate and toxicity of the chemicals found in the proprietary product IPAC SRB Plus.*

A. IPAC SRB Plus is a sulphur release aid that will be applied at each individual Rotoformer. As described in Volume I, Section 3.6: Air Emissions Management. IPAC SRB Plus contains no WHMIS controlled ingredients at concentrations requiring disclosure therefore, toxicity data is not available or required by WHMIS. This chemical remains in the cooling loop and is not released to the environment.

53. ***Volume I, Section 2.6.1.6, Page 31; Volume IIA, Section 2.1, Page 2-1.*** *With respect to storage of the sulphur, AST states, "Resulting pastilles…and deposited on an asphalt bulk storage pad with a capacity of 90 000 t. This storage pad will be shielded by the wind by a 6.1 m screen." AST also states, "Dust suppression will be implemented using a wind screen and proprietary dust suppression agents."*

a) *Provide a figure to show the location of the wind screen.*

b) *What evidence is there to support the conclusion that this screen will effectively prevent disturbance of the pile by wind? Provide the results of any tunnel, water plume, or field studies that have been completed. Comment on AST's plans to conduct any studies to determine the effectiveness of the proposed wind screen.*

c) *Does the usage of a wind screen represent best available technology for risk mitigation in this case? Discuss what other options AST has considered.*

A. The wind screen would be constructed around the outside perimeter of the sulphur stockpile, surrounding the south, southwest and west edges of the sulphur stockpile.

B. Wind screens have a long history of effective application in reducing windblown dispersion of materials contained in a stockpile. AST has selected this technology based on its experience but has not completed quantitative analyses regarding its effectiveness. Hence, there are no numerical analyses to share at this stage, as was requested. AST plans to evaluate the effectiveness of the wind screen by observing its performance during operation of the facility, and by completing the air and soil monitoring programs as described in the EIA. Should the wind action distribute the pastilles over a wider ground area within the vicinity of the Plant they should not become re-suspended (Watson et al. 2000). Opportunities to optimize the control of dust may become apparent depending on the results of these monitoring programs.

C. AST has considered enclosed storage silos, storage buildings, a wind screen and direct on ground storage of the sulphur pastilles. The use of storage buildings and storage silos are also very effective technologies for controlling wind-blown dust emissions. However, enclosure of the sulphur pastilles introduces new risks, such as concentration of dust, which are not present with the proposed storage plan. The wind screen was selected as the best option for controlling dust for the following reasons:

   i) it will effectively reduce wind velocities on the storage pile, and therefore, the tendency to generate wind-blown dust;

   ii) it allows for direct inspection and observation of the sulphur stockpile, thereby providing more immediate detection of potential fires;

   iii) the relatively coarse and hard sulphur pastilles are not particularly sensitive to windblown dust dispersion; and

   iv) there is no potential for concentration of sulphur dust.

54. ***Volume I, Section 2.6.2.1 and 5.4, Page 32 and 95.*** *AST states, "Continuous measurements of wind, H_2S and fine particulates (PM2.5) will be evaluated by AST through an air monitoring program at the boundary of the Site". AST also states "Annual ambient air and compliance source monitoring programs will be designed and implemented as a condition of the EPEA operating approval to be issued by AENV".*

    Is the monitoring program proposed on page 32 separate from the ambient air monitoring that will implemented as part of the EPEA approval?

    The ambient air monitoring program described on page 32 is expected to form part of the air monitoring program to be implemented as part of the EPEA approval. This is a decision that is made by Alberta Environment.

55. ***Volume I, Section 3.2.1, Page 63.*** *AST states, "maximum natural gas consumption will be approximately 20000 GJ/month for the full development".*

    a) *Provide an energy balance to show where the natural gas is being consumed at the proposed facility.*

b) *Provide a calculation to show the proposed natural gas usage at the proposed boilers.*

A. As stated in the response to SIR 7, there is no energy balance per se for the steam boiler system. Natural gas is only being consumed by the boiler. The boiler is sized to provide steam necessary to heat tanks, lines and buildings associated with the full development. It will operate at partial capacity during the initial stage of operation. At full scale operations, the boiler will consume approximately 100 tonnes of gas per month.

B. A more detailed description of the boiler is provided in the Design Basis included as Attachment 1.

56. ***Volume I, Section 3.2.1, Page 63.*** *AST states, "AST will maintain observational programs with respect to fine particulates and H_2S."*

a) *Provide a description of the observational programs.*

A. The planned observational programs were described in the EIA and are included below:

The proposed air monitoring program consists of three primary components, as follows:

- H_2S and SO_2 monitoring in the work area as a health and safety precaution for workers;
- Compliance Source Emissions Testing on Rotoform emissions; and
- Ambient air monitoring once per year to evaluate potential fugitive emissions of elemental sulphur.

The monitoring program for H_2S and SO_2 includes:

- personal monitors on all personnel working in the sulphur forming and processing areas; and
- continuous monitors in the vicinity of the liquid sulphur storage tanks, sulphur reception area and inside of the forming building.

The H_2S monitors will be set to alarm at a measured concentration exceeding 8 ppm. The SO_2 monitors will be set to alarm at a measured concentration of 4 ppm. Personal monitors will alarm at a level audible to the individual, whereas continuous monitors will alarm at the monitoring location and within the control room.

Annual ambient air and compliance source monitoring programs will be designed and implemented as a condition of the EPEA operating approval to be issued by AENV.

57. ***Volume 1, Section 3.6, Page 75.*** *AST states that SO_2 will potentially be formed at the facility.*

a) *Identify how and where SO_2 can potentially be formed at the facility.*

A. Sulphur dioxide may potentially be formed at the facility as a product of hydrocarbon combustion, or as a result of unplanned combustion of sulphur and/or sulphur dioxide. The potential area and point sources of SO_2 were identified in the Climate and Air Quality Assessment and are included below:

Volume IIA, Table 2.5-1 presents emission parameters associated with the point sources. They were based on stack survey results obtained from facilities similar to those being proposed by AST. Emissions of fine particulates are assumed to comprise sulphur particles.

Volume IIA, Table 2.5-2 presents emission parameters associated with area sources. Emissions from the trucks, locomotives, track-mobile and front end loader were based on exhaust specifications. Sulphur content for the diesel fuel consumed by the locomotive engine was assumed to be 500 ppm, while that consumed by trucks and front end loader was assumed to be only 15 ppm. Emissions from the asphalt pavement were obtained from estimation methods recommended by the United States Environmental Protection Agency (US EPA 2006, Internet Site) with the assumption that the silt covering the asphalt would be similar to that found in areas of sand and gravel operations. This is a conservative assumption because it does not allow for AST's commitment to sweep the area on a daily basis.

58. ***Volume 1, Section 5.4, Page 95****. On site monitors are set to alarm at levels that are quite high and might be indicative of off-site levels exceeding Alberta Ambient Air Quality Objectives.*

    a) *Explain why AST is having the monitors alarm at such high levels instead of at lower levels considering the off site impacts that might be associated with very high on site levels.*

    A. The results of the Cumulative Effects Analysis conducted in the Climate and Air Quality assessment indicate that the maximum predicted ground level 1 h average background concentration for H_2S is 8 ug/m^3 and for SO_2 is 120 ug/m^3. Based on these results, it was concluded that off site facilities would not affect the on site emission concentrations. The alarm levels are set to industry standard levels as a health and safety precaution for on site workers.

59. ***Volume I, Section 3.2.1, Figure 3.2-2, Page 64; Volume IIA, Section 2.5, Figure 2.5-1, Table 2.5-2, Pages 2-41 and 2-43.*** *There seems to be inconsistencies regarding tankages. For example, Volume I, Figure 3.2-2 shows 1 sulphur pit, 6 sulphur tanks and 1 sulphur feed tank; Volume IIA, Figure 2.5-1 shows 6 sulphur feed tanks and 2 molten sulphur tanks; and Volume IIA, Table 2.5-2 indicates there are 1 underground molten sulphur storage tank, molten sulphur storage tanks and 1 molten sulphur feed tank.*

    a) *Rectify the inconsistencies.*

    b) *Table 2.5-2 indicates total H_2S emissions from the molten sulphur storage are the same as those of the underground molten sulphur storage tank and molten sulphur feed tank. Explain.*

    c) *Provide sample calculations for the H_2S emissions from these tanks.*

    d) *Volume Application, Section 5.14 Page 15 indicates the sulphur load-out and transfer tanks are underground concrete tanks and Attachment D-A4 indicates there is only 1 steel sulphur receiving tank. Clarify.*

    A. The Figure shown as 2.5-1, and the process description included in Volume I are correct. Figure 3.2-2 was intended to illustrate only the Process Flow Diagram.

    B. H_2S may be liberated at the transfer points for the liquid sulphur through agitation. For the purpose of the air modelling component of work it was assumed that all residual H_2S would be

liberated at the transfer points; 90% of the liberated H_2S would be adsorbed by the SulfaTreat process; and that the maximum residual H_2S concentration was 10 ppm. Accordingly, the assumed H_2S emissions at each transfer point (liquid sulphur containing tank), was the same for each tank.

C. A sample calculation for the H_2S emissions from a tank is provided below in SIR 66.

D. Attachment D-A4 is in error. The receiving tank is an underground, concrete tank.

60. ***Volume IIA, Section 1.1.2.1, Page 1-4.*** *AST states, "Only liquid sulphur that has been degassed to a maximum of 10 ppm H_2S will be accepted."*

a) *Describe what procedures AST will be implement to ensure the liquid sulphur received has a maximum of 10 ppm H_2S.*

b) *Should the liquid sulphur contain H_2S greater than 10 ppm, how will it be handled?*

c) *For liquid sulphur that contains H_2S greater than 10 ppm, how long before it is returned to the generator?*

A. Sulphur generators will be contractually obligated to supply only degassed sulphur and will be required to submit evidence that the sulphur produced by their facility contains no more than 10 ppm H_2S by weight. Air quality monitoring at the receiving point (H_2S concentration and odours) will detect excess H_2S, should it be present.

B. If detected, sulphur receiving operations will be halted until the source of the H_2S is identified. Any sulphur that contains H_2S concentrations greater than 10 ppm will be returned to the sulphur generator. Processing activities will also be adjusted to ensure that any sulphur that has already entered the forming process is managed in such a way as to maintain appropriate air quality and safe working conditions.

C. The H_2S monitors at the receiving location measure airborne H_2S concentrations in real time so AST's reaction time at the point of receiving will be immediate. Suspect trucks or rail cars that contain the sulphur with potentially elevated H_2S will be held until H_2S analyses of the liquid sulphur are completed, which is estimated to be 24 to 48 hours. Any rejected sulphur will be immediately returned to the sulphur generator.

61. ***Volume IIA, Section 1.1.2.2, Page 1-4.*** *AST states, "Formed sulphur will be stored on a double – lined asphalt pad equipped with run-on and runoff controls. The pad has the capacity to store 90,000 t of finished product, approximately half of which will be established as part of the initial construction."*

a) *Explain why AST is not proposing to store the formed sulphur in an enclosed product storage facility.*

b) *Describe the differences in terms of dust control and dust emissions between an enclosed storage and the proposed storage as outlined in the application.*

c) *Explain why a capacity to store 90,000 t of finished product is required.*

d) *Discuss how product storage can be minimized during normal operation.*

A. AST is not proposing to store the formed sulphur in a fully enclosed storage facility because of safety concerns regarding the potential accumulation of sulphur dust and concerns regarding active emission controls needed on the emissions from such an enclosure.

B. Dust emissions from the proposed storage and transfer systems are associated with wind-blown dust and agitation-induced dust generated by the transfer operation. Windblown dust is minimized by manufacturing coarse, competent pastilles and by constructing the wind fence. Sulphur dust associated with the transfer activities is minimized by implementing appropriate management practices, good housekeeping, and by the effective application of dust suppressants. For the fully-enclosed option, dust is also generated by the transfer operations. Dust is controlled by implementing a vigorous ventilation system and by including active dust collection systems on the ventilation emissions. Also see response to SIR 53 c).

C. The 90,000 tonne storage capacity reflects approximately 2 weeks production at full rates and is intended to accommodate interruptions in the rail or port transfer operations.

D. Typically rail transfers will be pre-scheduled to remove each full load when this volume of formed sulphur has been generated. Accordingly, the volume of sulphur pastilles stored on the Site at any given point in time should not exceed about 18,000 tonnes. One unit train for formed sulphur would contain approximately 12,000 tonnes of sulphur.

62. ***Volume IIA, Section 1.1.2.4, Page 1-5.*** *AST states, "A wind screen will be built upwind of the sulphur pastille stockpile. Initially, a front-end loader will transfer the stockpiled sulphur to a surge bin equipped with a dust suppression package." "An automatic loading system will be introduced as part of future expansion to full capacity."*

a) *In terms of dust control, what are the advantages of an automatic loading system over front-end loader?*

b) *Why is an automatic loading system not being introduced for the initial stage?*

c) *For handling of formed sulphur, are the front-end loaders adequately equipped to mitigate potential ignition scenarios?*

A. In terms of dust control, the main advantages of automatic loading system are:

i) there are no housekeeping issues related to the trafficking of sulphur dust, and

ii) dust emissions occur at predictable points, allowing for dust controls to be installed at those points.

B. An automatic loading system is not being considered for the following reasons:

i) the loader operation can be managed in such a way as to limit dust emissions to a comparable level;

ii) automated loading systems are prone to clogging and consolidation of sulphur in the enclosure, which requires regular maintenance;

iii) dust surges often occur at the main transfer points when the system is started and stopped;

iv) the initial rate of sulphur forming does not justify a fully automated system; and

v) small sulphur fires can be started by sudden materials movements in enclosed and automated systems, and these fires are more difficult to detect than on an open pad.

C. Yes, the front-end loader will be adequately equipped to mitigate potential ignition sources. Protective measures in this regard include the following:

Conveyors

- All conveyors are covered to mitigate any wind-borne dust
- Conveyors from forming plant and load out equipped with sprinkler system

Front End Loader

- Equipped with spark arrestors
- Exhaust system and mufflers insulated
- Engine protected so that the maximum surface temperature is 100º C
- Leading edge of the bucket is constructed of a non sparking material (i.e. high density polyethylene with embedded carbon fiber)

Electrical Motors

- All motors are explosion proof

63. ***Volume IIA, Section 2.1, Page 2-1.*** *AST states, "Air emissions associated with the pastille forming, storage and shipping operations contains a wide variety of compounds, including: sulphur dioxide (SO_2) nitrogen oxides (NO_X), carbon monoxide (CO), fine particular matter ($PM_{2.5}$)" and "The project will not have any significant air emissions.".*

a) *Explain why H_2S is not included.*

b) *Describe how these compounds (including H_2S) are produced.*

c) *Describe the environmental impacts associated with these compounds (including H_2S).*

A. The list provided in the referenced Introduction to this component of the EIA was intended to be illustrative and not exhaustive. H_2S was included in the assessment of air quality. The modelling work completed in this regard concluded that predicted H_2S emissions were very low relative to the Alberta Ambient Air Quality Objectives.

B. H_2S may be entrained in the liquid sulphur and can be liberated through the transfer and forming processes. Because AST will only accept degassed sulphur for processing and because H_2S adsorption measures are incorporated into the tank vents at the major liquid sulphur transfer points, H_2S emissions associated with the process will be very small. SO_2 can be generated by the oxidation or combustion of H_2S, or by the unplanned combustion of sulphur. NO_x is produced as the result of high temperature combustion resulting in the oxidation of ambient nitrogen and can occur though operation of the gas boiler or mobile

equipment such as the loader. CO and $PM_{2.5}$ are products of incomplete combustion and are also generated by operation of the gas boiler and mobile equipment.

C. The human health and potential environmental impacts associated with these substances are described in Sections 2 and 4 of Volume IIA. Briefly, at high concentrations both H_2S and SO_2 can be acutely toxic. At lower concentrations these substances elicit a strong and obnoxious odour. CO may be similarly acutely toxic but does not generate an obnoxious odour. Fine particular matter can become entrained in our lungs, which in turn can result in adverse effects to our respiratory systems. Above certain concentrations, NO_x can impact the respiratory system and under certain weather conditions (that are not typically present at Bruderheim) can generate smog. Emissions of these substances associated with the Project will be small. The air quality assessment concluded that the Project will not cause exceedences of the AAAQO and therefore, no material environmental or health effects are anticipated. The air quality objectives that are used for reference in the air quality assessment (Section 2 of Volume IIA) account for these potential impacts.

64. ***Volume IIA, Section 2.1, Page 2-2****. AST states, "The project will not have any significant air emission of non-criteria contaminants such as VOCs (e.g., benzene, toluene) or polycyclic aromatic compounds (PAH) (e.g. benzo(a)pyrene, chrysene)".*

a) *Provide evidence to support the claim that emissions of VOCs and PAH are not significant.*

A. Estimates of specific VOCs and PAHs emissions have been compiled by JWEL and forwarded to Intrinsik for analysis of potential health effects. The toxicity potency screening results are presented in SIR 84.The final air dispersion modelling of the VOCs and PAHs identified in SIR 84 will be forwarded to AENV and Alberta Health and Wellness under separate cover. From past experience and from reasonable deduction we know that the emissions associated with two or three units of mobile equipment and from a medium sized, commercially available gas boiler do not result in significant risk to human health.

65. ***Volume IIA, Sections 2.3.2.1 and 2.4.4.2, Pages 2-9 and 2-37.*** *With respect to deposition criteria, AST states, "AENV has adopted critical, target and monitoring loads for PAI for evaluating and managing the effects of industrial emissions of acidifying gases (CASA and AENV 1999)" The RELAD model is run as part of this provincial process to evaluate and manage acid deposition and the results are applied to grid cells which are 1° latitude by 1° longitude in size. AST also states, "The CALPUFF model has been used to provide predictions of acid deposition within the study area as required by the Terms of Reference (TOR) (AENV 2007). In the context of the provincial acid deposition management framework (CASA and AENV 1999), deposition values obtained using this model may be useful in determining where monitoring efforts, if required, should be best directed."*

a) *Are the CALPUFF predictions based on 1° latitude by 1° longitude grid cells, for comparison with the provincial deposition monitoring criteria? If not provide justification for an alternate approach.*

A. CALPUFF predictions based on 1° latitude by 1° longitude grid cells would serve no useful purpose. Only results based on calculations using the RELAD model have status with respect to the management and assessment of acid deposition within Alberta (CASA and AENV 1999).

A recent assessment has concluded that there should be no issues with respect to acid deposition within the province until at least 2010 (AENV 2007). This assessment included the area surrounding the proposed Project.

66. ***Volume IIA, Section 2.5, Page 2-40.*** *AST states, "Emissions associated with trucks, locomotive, trackmobile, storage tanks and front-end loader will comprise area sources." and "Exhausts from storage tanks will be subject to the SulfaTreat process to ensure that H_2S concentrations do not exceed 1 ppm by volume."*

a) *Volume Application, Section 5.13.2, Page 13, AST states, "The H_2S monitors will be set to alarm at a measured concentration exceeding 8 ppm" What monitoring programs will AST implement to ensure H_2S emissions will not exceed 1 ppm?*

b) *As shown on Figure 2.5-1 there are three SulfaTreat vents associated with the storages tanks. Explain why emissions from storage tanks are considered to be area sources instead of point sources. Provide a detailed calculation of how H_2S emissions were calculated from the storage tanks and how those emissions were apportioned to an area source.*

c) *How will the impact assessment be affected if emissions from storage tanks are considered to be point sources?*

d) *Volume IIA, Appendix I, Table I-1, Page I-2 indicates H_2S concentration of 1 ppm has noticeable odour, maybe considered 'offensive' by some individuals." Discuss technologies that are available to reduce emissions from the SulfaTreat vents to less than 1 ppm H_2S and any plans to implement these technologies.*

e) *Discuss steps and procedures that will be implemented by AST to ensure the SulfaTreat units are operated at maximum efficiency.*

f) *Why have SO_2 emissions from the storage tanks not been considered?*

A. To clarify, liquid sulphur will only be accepted by the proposed Bruderheim facility if it has been degassed to a level below 10 ppm H_2S entrained in the liquid sulphur. The SulfaTreat process adsorbs 90% of the H_2S that may be present in the vapours emitted from the tank vents. Hence, use of the SulfaTreat process is equivalent to the handling of liquid sulphur containing less than 1 ppm H_2S, from the perspective of predicting H_2S concentrations in air. The H_2S modelling was completed assuming that the sulphur accepted by the facility would contain 10 ppm H_2S, that 90% of this H_2S would be adsorbed by the SulfaTreat process, and that the remainder of the H_2S would be emitted to atmosphere at the various transfer points. This is considered to be a reasonable and conservative approach to predicting H_2S concentrations resulting from facility operations.

The monitoring program was designed to ensure that ambient on site concentrations of H_2S would not exceed the occupational health standard of 10 ppm. Ambient measurements of H_2S at a continuous monitoring station located at the plant boundary will be used to ensure that off-

site concentrations do not exceed the AAAQO of 10 ppb. (There are currently no plans for a monitoring program to ensure that H_2S emissions will not exceed 1 ppm.)

B. AST plans to design an H_2S recovery system based upon processes such as SulfaTreat to ensure that effluent from the liquid sulphur storage tanks contain a maximum H_2S concentration of 1 ppm. Air emissions from these tanks will depend upon the rate at which head space is being occupied by liquid sulphur during the filling process (Table 66-1).

Table 66-1: Estimated H_2S Emissions for Sulphur Tanks

Underground Tanks	
Maximum tank volume (m^3)	192
Maximum S capacity (t)	344
Maximum Rate at which S is being downloaded (t/h)	250
Replaced volume (m^3/h)	140
H_2S Emission (g/s)at 1ppmv outlet at 25°C	0.000054
H_2S Emission (kg/day)	0.0047
Above Ground Tanks	
Continuous production flow (t/h)	250
Replaced volume (m^3/h)	140
H_2S Emission (g/s)at 1ppmv outlet at 25°C	0.000054
H_2S Emission (kg/day)	0.0047

There was some uncertainty as to the actual configuration of emission stacks associated with the SulfaTreat process. It was decided for purposes of air quality assessment to consider them as effective area sources. It was understood that air quality modelling results would not be sensitive to this assumption (Tables 66-2 and 66-3).

Table 66-2: Emission Parameters for Tank Vents as Point Sources

Parameters	**Point Sources**		
Source ID	**Underground Molten Storage Tank**	**Molten Sulphur Storage Tank**	**Molten Sulphur Feed Tank**
UTM (m E)	377073	377091	377061
UTM (m N)	5962100	5962104	5962142
Base elevation (m)	636	636	636
Stack Height (m)	2.5	2.5	2.5
Stack Diameter (m)	0.152	0.152	0.152
Exit Temperature (K)	298	298	298
Exit Velocity (m/s)	1.02	1.02	1.02
H_2S Emission Rate (g/s)	0.000054	0.000054	0.000054

Table 66-3: Emission Parameters for Tank Vents as Area Sources

Parameters	Area Sources		
Source ID	**Underground Molten Storage Tank**	**Molten Sulphur Storage tank**	**Molten Sulphur Feed Tank**
UTM (m E)	377073	377091	377061
UTM (m N)	5962100	5962104	5962142
Base elevation (m)	636	636	636
Release Height (m)	2.5	2.5	2.5
Length of Area (m)	1	1	1
Width of Area (m)	1	1	1
H_2S Emission Rate ($g/s/m^2$)	0.000054	0.000054	0.000054

C. Figures 66-1 and 66-2 present dispersion modelling results for maximum hourly average ground-level concentrations based upon the assumption that the tank vents behave respectively as area and point sources. The results are, as expected, virtually identical. This is because the area source dimensions are small compared to the size of the plume as it spreads at downwind distances to the Plant boundary. Additional calculations for daily averages showed that results for assumed area and point sources were also virtually indistinguishable.

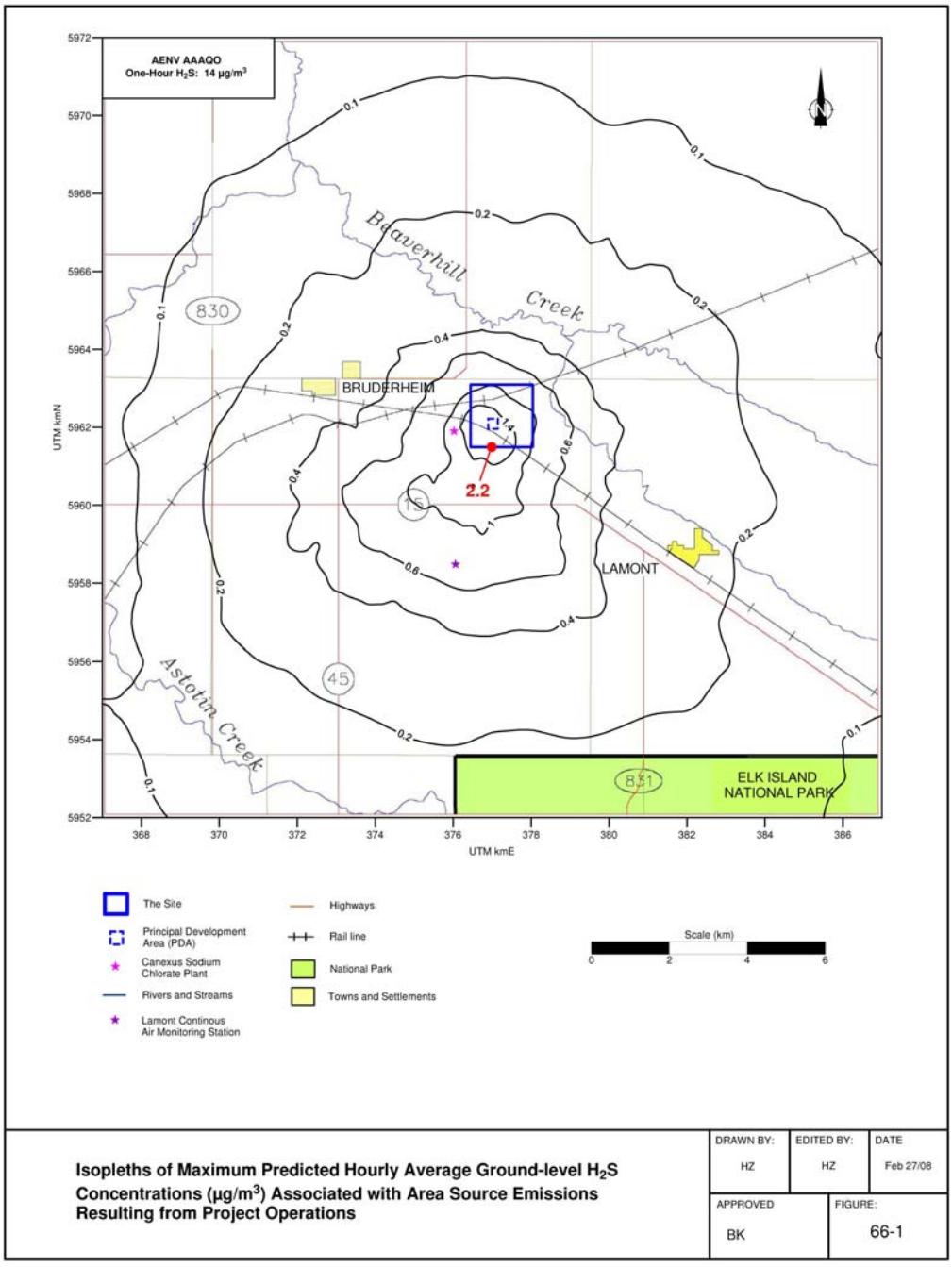


Figure 66-1: Isopleths of Maximum Predicted Hourly Average Ground-level H_2S Concentrations (µg/m^3) Associated with Area Source Emissions Resulting from Project Operations

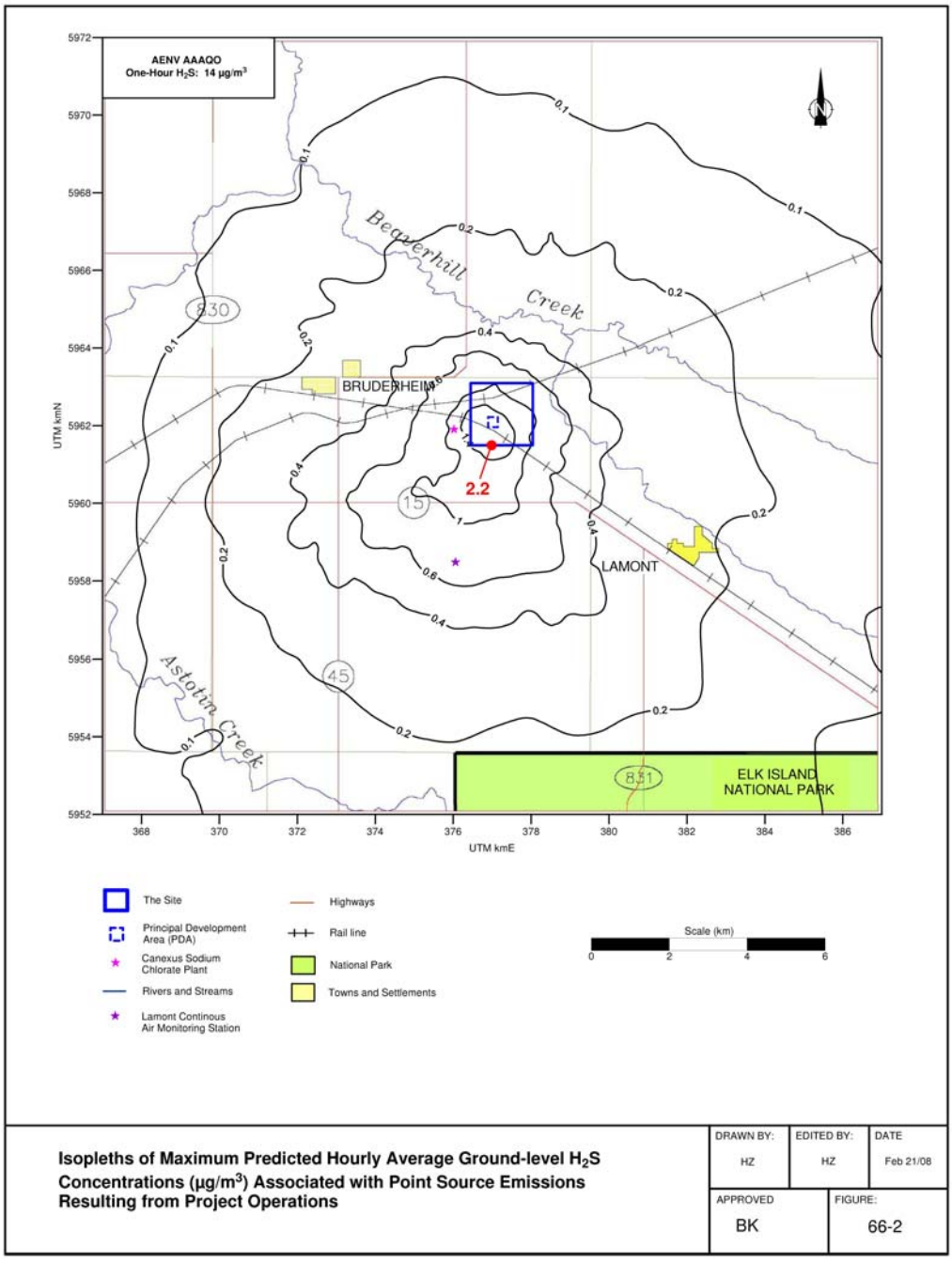


Figure 66-2: Isopleths of Maximum Predicted Hourly Average Ground-level H_2S Concentrations (µg/m³) Associated with Point Source Emissions Resulting from Project Operations

D. There is no intention to reduce emission concentrations of H_2S from these tank vents to less than 1 ppm. Atmospheric dispersion processes will quickly dilute the emissions to less than this value. Nonetheless, there may be noticeable on site odours on an occasional basis within the near vicinity of the vents. It is noted that maximum predicted hourly ground level H_2S concentration at the property boundary is 2.2 ug/m^3, which is approximately equal to 0.002 ppm H_2S.

E. The performance of the SulfaTreat process will be indirectly monitored through the air and odour monitoring activities that are implemented as part of routine facility operations. If odours or increasing H_2S concentrations are noticed, the vented gas from the SulfaTreat units will be directly tested. SulfaTreat is a passive adsorption process; hence, maintenance will involve replenishing the adsorbent media (iron sponge).

F. SO_2 may be generated by the combustion or oxidation of H_2S. No combustion of H_2S is expected to occur at liquid storage tank locations. Some more gradual oxidation of H_2S is anticipated as a result of venting H_2S to the atmosphere. Given the low concentrations of H_2S that are predicted and the gradual nature of the H_2S oxidation process, SO_2 concentrations are not expected to be significant. SO_2 concentrations generated by unplanned combustion of sulphur are expected to be much more significant and were modelled.

67. ***Volume IIA, Section 2.5, Page 2-40****. AST states, "Measurements have shown that 99.8% of the sulphur particles associated with the pastille forming process retain diameters of greater than 2 mm".*

a) *Provide measurement data to support this statement.*

A. The grain size distribution of disturbed sulphur pastilles that supports this statement is included in the air modelling report completed to support the original application and is enclosed as Attachment 4 for convenience.

68. ***Volume IIA, Section 2.5, Page 2-40.*** *AST states, "Table 2.5-1 presents emission parameters associated with the point sources. They were based on stack survey results obtained from facilities similar to those being proposed by AST."*

a) *Provide the stack survey results and indicate which specific, existing, similar facilities the stack information was obtained from.*

b) *What are the production rates and processing capacities at these facilities?*

c) *Provide evidence to confirm that emissions can reliably be based on the other facilities.*

d) *What are AST's plans if emissions from the Rotoform stacks are higher than predicted and adverse off sit impacts occur during operation?*

e) *Why have SO_2 emissions from the Rotoform stacks not been considered?*

A. The stack survey results that were used for reference were obtained from surveys conducted on behalf of Shell for the Shantz facility. These data have been submitted by Shell to Alberta Environment. Copies are attached as Attachment 5 for convenience.

B. The production rate and forming facilities at Shantz are essentially the same as those proposed as part of the Project.

C. Because the forming process, equipment and capacity at Shantz are so similar to that which is proposed for Bruderheim, it is our opinion that the comparison is valid.

D. AST will fully evaluate and improve the operation of the forming units if their performance is significantly different from the Shell Shantz experience. Because the forming units are the same, performance should be similar.

E. The Rotoform stacks are not venting SO_2, hence there is no utility in modelling SO_2 emissions. Similar to our response to SIR 66F (above), SO_2 emissions associated with oxidation of H_2S are expected to be insignificant relative to the SO_2 emissions associated with unplanned combustion of sulphur, which has been modelled.

69. **Volume IIA, Section 2.5, Page 2-40.** AST states, "*Table 2.5-2 presents emission parameters associated with the area sources. Emissions from the trucks, locomotives, trackmobile and front end loader were based on exhaust specifications*"

a) *Provide references to where the exhaust specification information was obtained.*

b) *Provide example calculations for the estimation of the area source emissions.*

A. AST provided information relating to engine horse power (HP) and diesel fuel consumption. Air emission factors relating to horse power and fuel consumption were then obtained from the following sources:

- US EPA (2004) "Exhaust and Crankcase Emission Factors for Nonroad Engine Modelling – Compression-Ignition" http://www.epa.gov/OMS/models/nonrdmdl/nonrdmdl2004/420p04009.pdf
- US EPA (1997) "Emission Factors for Locomotives" http://www.epa.gov/oms/regs/nonroad/locomotv/frm/42097051.pdf
- Environment Canada (2004) " Regulations Amending the Sulphur in Diesel Fuel Regulations" Canada Gazette, Vol. 138, No. 40, October 2, 2004
- Hsu Y., Roe S., Holoman D., Divita F., Pechan E. H. & Associates Inc (2005) "New Upgrades to EPA's SPECIATE Database." http://www.epa.gov/ttn/chief/conference/ei14/session11/hsu.pdf
- Cook, R and Sommers, J., "Revised Methodology and Emission Factors for Estimating Mobile Source PAH Emissions in the National Toxics Inventory" http://www.epa.gov/ttn/chief/old/nti/pahmethod.pdf

B. Estimated emissions from each source type were distributed evenly over the area assumed to be occupied by the source during the time period considered.

For example, CO emissions from the front end loader (Model: CAT 980H) were estimated using its engine horsepower (355 hp) time emission factor (2.6 g/hp-hr):

355 hp*2.6 g/(hp-hr)=923 g/hr =923 g/hr* hr/3600s =0.26 g/s

The front end loader was assumed to be working over a loading area of 300 m^2. Thus, areal CO emissions for the front end load are:

0.26 (g/s) /300 m^2=0.00086 g/s/m^2.

70. **Volume IIA, Section 2.5, Appendix 1, Table 2.5-1, Pages 1-iii and 2-42.** AST states, "*There should be no noticeable changes in air quality with respect to adverse effects on the environment (including odours and visibility)…*" Table 2.5-1 indicates that H_2S is emitted from sources at the facility. H_2S has a distinctive foul odour.

a) *Compare maximum predicted H_2S concentrations for the cumulative case to a recognized odour threshold to indicate the potential for odour issues.*

A. The highest predicted ground-level H_2S concentration attributable to Project emissions at the Plant boundary is 2.2 µg m^{-3}. Such a concentration is anticipated to occur only about once every four years. Background sources have been very conservatively assumed to be as high as 8 µg m^{-3}. On this basis, the cumulative total H_2S concentration could theoretically reach values as large as 10.2 µg m^{-3}. The maximums are localized and occur in uninhabited areas.

Hydrogen sulphide has a strong unpleasant odour. The threshold of this odour is low, but shows wide variation among individuals. A level of 7 µg m^{-3}, based on a 30 minute average was estimated by a task force of the International Programme on Chemical Safety (IPCS 1981) to 'not produce' odour nuisance in most situations.

Amoore (1985) analyzed a large number of reports from the scientific literature and found that reported thresholds for detection were log-normally distributed, with a geometric mean of 10 µg m^{-3}. Detection thresholds for individuals were reported to be log-normally distributed in the general population, with a geometric mean of 4.0, i.e., 68% of the general population would be expected to have a detection threshold for H_2S between 2.5 and 40 µg m^{-3}.

Amoore (1985) drew attention to the difference between detection threshold and the levels at which odour could be recognized, or at which it was perceived as annoying. Analysis of various laboratory and sociological studies suggested that the level at which an odour could be recognized was typically a factor of three greater than the threshold for detection, while the level at which it was perceived annoying was typically a factor of five greater than the threshold. He therefore predicted that, although at 10 µg m^{-3} 50% of the general population would be able to detect the odour of hydrogen sulphide only 5% would find it annoying at this level.

Based on the above discussion, it can be concluded that there is very little potential for odour issues to arise as a result of Project emissions. This is because cumulative H_2S concentrations in the order of 10 µg m^{-3} will be very rare; they will occur in uninhabited areas; they will be transient in nature; and will be found annoying by a only a small fraction of the population. In addition, should an annoyance be reported, it is more like to be attributable to background sources whose potential impacts appear to be much larger than those attributable to Project operations.

71. **Volume IIA, Appendix 1, Section 3.3, Page 1-8 and Table 1-1, Page 1-2.** AST states, "*For this assessment, CALPUFF was run using data for the four-year period of 2002-2005 as obtained from the Fort Air Partnership's (FAP) Lamont monitoring station*"

    a) *Justify the use of the Lamont (ISC) meteorological data rather than a refined 3 dimensional data set, processed by the CALMET meteorological data preprocessor, for use in CALPUFF.*

    A. The Lamont meteorological data was used for the following reasons:

        i) The Lamont station is situated in the near vicinity of the Project.

        ii) The Lamont data comprises 5 years of observations. Therefore, it contains a much wider range of data than the CALMET data set against which the air quality assessment can be evaluated.

        iii) The use of the 5 year data set from the Lamont monitoring station is compliant with modelling requirements as outlined by Alberta Environment's Air Quality Model Guideline.

72. **Volume IIA, Appendix 1, Section 3.1, Table I-1, Page 1-2.** Table I-1 (Group 2: Technical Options) indicates that the PRIME method was applied to consider building effects.

    a) *Provide a table presenting the dimensions for the proposed buildings at the AST facility that were used in the dispersion modelling.*

Table 72-1: Building Dimensions

Building ID	Height (m)	Length (m)	Width (m)
Rotoform Building	13.4	132.2	31
Cooling Tower 1	3.8	7.3	6.6
Cooling Tower 2	3.8	7.3	6.6
Boiler 1	13.4	10.0	7.7
Boiler 2	13.4	10.0	7.7
CHEM Building	3.0	7.3	3
Maintenance Building	3.0	18.3	3.7
Office Building	3.0	18.3	3.7
MCC Building	3.0	7.3	3.0
MOLTEN1	6.7	4.9	4.9
MOLTEN2	6.7	4.9	4.9

1.6 HEALTH

73. ***Volume 1, Section 3.2.1, Page 63****. AST states "there will be no significant waste streams generated by the process; however, over the operating lifespan of the Project, minor volumes of off-specification sulphur and water neutralization precipitates (primarily gypsum) are expected to be generated from time to time".*

a) *Discuss the potential impacts to human health from exposure to off-specification sulphur and gypsum.*

A. Elemental sulphur and gypsum are two very low toxicity substances. Management of these materials as wastes occur very infrequently, during clean-up and disposal operations. Standard procedures for managing these wastes will be implemented and personal protective equipment will be worn by workers during these activities to minimize potential exposure to workers and the public.

74. ***Volume 1, Section 3.6.1, Page 76.*** *AST states "the transportation of sulphur to and from the facility will occur in any event and hence does not add to the overall emissions of GHG".*

a) *Discuss how transportation to the site will not contribute to overall emissions of GHG.*

A. The forming and transportation of sulphur must occur at some location if that sulphur is to be used beneficially. The proposed Bruderheim Site is located directly on the rail lines that transport formed sulphur to the west coast for shipment. The proposed Site is also efficiently located between the generating locations (primarily the upgaders of the Industrial Heartland and the oil sands region) and these rail lines. Hence, it can be reasonably concluded that the GHG emissions generated by the transportation of sulphur to and from the proposed Bruderheim facility would be no greater than those associated with other sulphur forming and shipping options available to the sulphur generators. This information is presented in Volume I, Section 2.2.

75. ***Volume IIA, Section 2.1, Page 2-1.*** *AST states "exhausts from the storage tanks will be subject to the SulfaTreat process to ensure that H_2S concentrations do not exceed 1 ppm by volume".*

a) *What will be released in these "exhausts" and discuss the potential impacts to human health.*

A. H_2S may be released in trace concentrations from the tank vents. No other trace chemicals associated with the sulphur containment are expected to be present. The SulfaTreat adsorption process is expected to recover over 90% of the hydrogen sulphide contained in these tank vapours. Because the maximum H_2S content in the liquid sulphur will be 10 ppm, the SulfaTreat process has the overall effect of reducing the H_2S vapours to those associated with liquid sulphur degassed to a concentration no greater than 1 ppm. H_2S modelling and the related potential effects to air quality and human health are described in detail in Volume IIA.

76. ***Volume IIA, Section 2.1, Page 2-1.*** *AST states that air emissions associated with pastille forming include SO_2, NO_X, CO, and $PM_{2.5}$. This list does not appear to include all compounds potentially emitted by the project. The list does not include metals and hydrocarbons that may be emitted during fuel combustion (e.g., vehicle and equipment operation during construction and operations).*

a) *Provide an updated, comprehensive air assessment that takes in to account all contaminants that may be emitted by the project.*

b) *Update the HHRA accordingly.*

A. Please refer to the answer to SIR 84 below. Note that the updated HHRA will only characterize the potential health risks associated with the Project's PAH and VOC emissions, as the Project is not expected to emit metals.

77. V**olume IIA, Section 2.3.1.3, Page 2-6.** AST states "*Information relating to regional ground-level concentrations of the criteria pollutants is available from continuous monitoring stations operated at Fort Saskatchewan, Lamont and Elk Island. Locations of these stations are shown in Figure 2.3-1. Their sites were chosen so that air quality measurements would be representative of regional conditions. For this reason they may not always be situated in areas where industrial air quality impacts are predicted to be at their maximum values*".

    a) *Provide additional rationale for not using maximum values for regional ground-level concentrations of the criteria pollutants.*

    A. The observed data collected at the Lamont monitoring station, located near the Project, should be representative of air quality conditions that occur in the vicinity of the Project. Observed data are always to be preferred to theoretical or predicted data.

    Maximum predicted concentrations usually occur near the fenceline, close to the emitting industries. Fencelines of the major industries considered in this study tend to be at downwind distances of ten or more kilometres from the proposed AST facility. They are thus far removed from the Local Study Area in which Project emissions will have a significant influence.

78. **Volume IIA, Section 2.4.3.2, Page 2-16.** With respect to monitored H_2S, AST highlights two separate monitoring periods, the first one from January 1, 2003 until June 30, 2005; and the second from July 1, 2005 to October 31, 2006. AST states: "*An examination of Figure 2.4.3 shows that significantly higher H_2S concentrations occurred during the first period.*" Furthermore, AST states: "*It has been assumed in this report that values of H_2S observed since June 30, 2005 best represent current conditions within the LSA.*" The first reporting period is for a longer duration and includes several more observations (20 806 versus 11 137).

    a) *Provide the rationale for using the second reporting period as a background, since the first is much more comprehensive and may give a better overall estimation of H_2S in the LSA. Include a detailed explanation that supports the use of the second monitoring period.*

    A. The period of the second data set is some 15 months in length. It is sufficiently long in duration to establish that the source of the relatively high H_2S concentrations evident in the first observational period is no longer present in the area. Perhaps this is because the source was transitory in nature (e.g., sour gas well testing?) or because emissions from a given plant were reduced.

    Because of the suspected absence of the H_2S source the second and most recent monitoring period is most representative of current background conditions.

79. ***Volume IIA, Sections 2.5 and 2.5.5, Pages 2-40 and 2-58.*** *AST states "dust suppression chemicals will be sprayed on the pastilles at all conveyor transfer points".*

    a) *Provide more information on the dust suppression program, including methods, materials/chemicals used and frequency of implantation.*

b) *Discuss the potential for the chemicals used to impact human health.*

A. The dust suppressant will be applied on a semi-continuous basis in accordance with the manufacturer's instructions. The trade names for the products are IPAC Dustbind S5 and IPAC SRB Plus. Each of these dust suppressants are diluted in water and are applied as a fine spray. Suppressants would only be applied to the maximum concentration recommended by the manufacturer when dusty conditions prevail. The maximum application rate is 100 kg per day, based on 6,000 tonnes per day sulphur throughput.

B. MSDS sheets for both chemicals are included in Volume I. IPAC SRB Plus is a very low toxicity suppressant and does not contain hazardous ingredients above reportable concentrations. IPAC Dustbind S5 contains glycol, substituted alcohol and a substituted sulfonate, each of which, has low reported toxicity. Workers will wear standard personal protective equipment as recommended in the MSDSs. Given the low toxicity of these suppressants, the large distance between their use and adjacent residents (over 500 metres), and the low proportions of suppressants that are used (less than 0.002%), there is no basis to anticipate health impacts to adjacent residents.

80. **Volume IIA, Section 4.4.1, Page 4-6.** The receptor characterization did not address the on- and off-site receptors.

a) *Were the Maximum Points of Impingement (MPOIs) based on the highest predicted ground level air concentration regardless of whether it is located on- or off-site or were the MPOIs based solely on off-site locations?*

b) *Clarify whether or not the public will be allowed on site.*

A. The MPOIs were based on hypothetical locations determined in the Climate and Air Quality assessment (Volume IIA, Section 2) and are located on site.

B. The policy for visitors arriving and entering the Site is described in the Health and Safety Plan provided in Appendix IV of Volume I. No unaccompanied or unmonitored public access to the Site will be permitted.

81. **Volume IIA, Section 4.4.2.2, Page 4-6.** AST states: "*As significant surface water releases to the environment are unlikely to occur, exposure via surface water was considered to be a closed exposure pathway, and thus is not of concern to human health*."

Volume IIA, Section 4.4.2.3, Page 4-6 *AST states: "With the appropriate implementation of the planned mitigation measures, groundwater quality during the Project lifetime will not be significantly affected by Project related activities or surface releases during construction and operations…When considering the long travel time of groundwater to the nearest domestic water wells and the mitigation measures planned for the Project, groundwater quality is not anticipated to be adversely affected. Therefore, groundwater quality was not considered to be an operable exposure pathway for the HHRA." A quantitative assessment of groundwater impacts was not provided; therefore it is not appropriate to conclude that human health will not be affected by groundwater exposure. Moreover, the fact that it will take 100 years for groundwater contaminated*

at the site to migrate to the nearest well, is not justification for a conclusion that the risk is negligible.

As well, it is inappropriate to eliminate an exposure source that contains Chemicals of Potential Concern (COPCs), since this will underestimate overall exposure to the chemicals. Even if the project does not increase the concentrations in the soil, the soil will still contribute to overall contaminant exposure and should be included in a multi-media HHRA.

a) *Provide an updated HHRA, which includes these exposure pathways.*

The chemicals of potential concern (COPCs) selected for the HHRA were expected to have a potential effect on air quality only. No relevant secondary exposure pathways were identified for these compounds (Sections 4.4.2 and 4.4.3 in Volume IIA).

These COPCs were modelled in the Climate and Air Quality section of the EIA to determine potential air quality impacts. The air dispersion modelling indicated emissions of these COPCs are predicted to be well below AAAQO. The HHRA in the EIA included inhalation only as an exposure pathway because these COPCs would not move through multi-media pathways, therefore the applicable exposure pathway for this HHRA is inhalation.

Following the filing of the EIA, Alberta Health and Wellness (AHW) requested that VOCs and PAHs be included in the COPCs. The scope of work pertaining to this request is summarized in Attachment 6. SIR 84 presents the results of the emissions profile screening and the toxicity potency screening conducted as part of this scope of work. Air dispersion modelling for the selected VOCs and PAHs will be conducted under separate cover and submitted to AHW. The nature of the screened VOCs and PAHs supports the current assessment approach evaluating inhalation as the exposure pathway.

An updated HHRA including surface water and groundwater exposure pathways has not been conducted. Volume I, Section 3.5.2 describes the surface water management plan to be implemented at the facility. The Project is designed to be a zero discharge facility. The results of the Surface Water Quality assessment are presented in Volume IIB, Section 4. Based on the management plan and the results of the assessment, professional judgment supports the original decision to consider surface water as a closed pathway in the current HHRA.

Volume IIB, Section 2 presents the results of the Groundwater Quantity and Quality assessment. Additional results assessing groundwater quantity were submitted to AENV under separate cover following the completion of the long-term pumping test. Based on the results of these assessments, professional judgment supports the original decision to consider groundwater as an inoperable pathway in the HHRA. This conclusion is supported by the absence of predicted impact to groundwater quality, the reactive nature of sulphate (the COPC associated with sulphur management), the very low groundwater flow velocity, and the absence of significant hydraulic connection between the aquifer used for domestic water supply and the uppermost groundwater bearing zone.

According to the soil assessment (Volume IIC, Section 2.6.7), in the event of either a spill or uncontrolled discharge at the site, any resultant soil contamination would remain localized. The potential for soil quality to be affected will be minimized through the application of a management

plan that emphasizes prevention of contamination and immediate response to an accidental spill, leak or discharge.

As discussed in Section 2.6.10 (Volume IIC), potential soil acidification from aerial deposition of elemental sulphur will primarily be contained within the PDA. Potential off-site impacts will be managed through an active monitoring program and mitigative measures such as liming if deemed necessary. Please refer to the response to SIR 82 for further detail on this.

82. ***Volume IIA, Section 4.4.2.4, Page 4-6 to 4-7.*** *The soil exposure pathway was not included in the HHRA, since "…the chemicals emitted from the Project are sufficiently volatile to prevent them from depositing onto soils in appreciable quantities".*

    a) *A quantitative assessment of predicted soil concentrations is required to make this conclusion. Provide this assessment.*

    b) *Provide an updated HHRA, which includes this exposure pathway.*

    A. The only COPCs identified in the Air Quality Assessment and HHRA were: CO, H_2S, NO_2, SO_2, and $PM_{2.5}$. The potential health effects caused by these compounds are associated with inhalation only as they primarily act at the point of contact (i.e., respiratory system). These compounds do not accumulate through the food chain. As a result, these compounds were only included in the inhalation assessment. For this reason, soil concentrations were not predicted for these compounds.

    B. Due to the volatile nature of the COPCs and the fact that their toxic effect is associated with air concentrations only, the soil exposure pathway was not included in the HHRA

83. **Volume IIA, Section 4.4.2.5, Page 4-7.** AST states: "*Due to the nature of the compounds the Project will emit into ambient air (i.e., gaseous), no plant samples were analyzed in support of the HHRA. Food quality is not expected to be impacted as a result of the project and any related ingestion pathways were therefore excluded*."

    a) *Food ingestion contributes to overall exposure and therefore must be included in a HHRA. Provide an updated HHRA, which includes this exposure pathway.*

    A. The COPCs identified for the HHRA act on the respiratory system. For these compounds, potential health risks can only be characterized by comparing predicted air concentrations against health-based air quality guidelines. Because food ingestion is not expected to contribute to overall exposure to CO, H_2S, NO_2, SO_2 or $PM_{2.5}$, it was not included in the HHRA.

84. ***Volume IIA, Section 4.4.3, Page 4-7****. AST only identifies CO, NO_2, SO_2, $PM_{2.5}$, and H_2S as COPCs for the project. AST states: "Combustion of fuels associated with the area sources could result in VOC and polycyclic aromatic hydrocarbon (PAH) emission into ambient air. However, taking in to account the nature and scope of the Project, and the results of air quality assessments of five recent upgrader applications in the region…the Project's contribution to area VOC and PAH concentrations is considered inconsequential." While the Project may emit a relatively small amount, it will still contribute to the overall contaminant load and therefore must be assessed in the HHRA in a quantitative manner (including a multi-media risk assessment).*

a) *Provide the required assessment.*

A. In accordance with the December 10, 2007 letter addressed to Alberta Health and Wellness (Attachment 6), PAHs and VOCs associated with the proposed Project considered to pose the greatest potential risk to public health were identified by comparing the annual emissions of each compound against their respective toxicity reference values (TRVs).

In addition to the emissions exhibiting most of the profile's toxic potency, any compounds that have been previously identified as posing a potential risk to public health automatically "qualified" for quantitative analysis in the human health risk assessment (HHRA) of the non-criteria air contaminants.

Review of recent HHRAs in the area indicate that elevated health risks have been identified for the following compounds:

- Acrolein (All)
- Formaldehyde (Total Upgrader)
- Hydrogen sulphide (Total Upgrader)
- PM2.5 (PCOSI Sturgeon Upgrader, Total Upgrader)
- Sulphur dioxide (All)

Of these, hydrogen sulphide, $PM_{2.5}$ and sulphur dioxide were assessed in the original HHRA and are therefore not included in any subsequent HHRA work. Because acrolein and formaldehyde were not assessed in the original HHRA, potential health risks posed by these compounds will be assessed in the upcoming air dispersion modelling as per the scope of work described in Attachment 6.

As described, the emissions were screened according to their cumulative toxic potency as well. To identify the toxic potency of the chemicals of potential concern (COPCs), the following steps were taken:

- Generate a list of emission rates for all products of incomplete combustion (PICs) associated with the Project (e.g., PAHs and VOCs)
- Identify chronic oral and inhalation TRVs for all PICs. The TRVs adopted for the current exercise represent the most stringent of those limits published by Health Canada and the United States Environmental Protection Agency.
- Calculate the toxic potency of each chemical using the following equation:
- Toxic Potency = Emission Rate ÷ TRV
- Sort the emissions profile by relative toxic potency
- Identify those chemicals that make up 99% of the emission profile's cumulative toxic potency.

The results of the toxic potency screening exercise are presented in Tables 84-1 and 84-2 using inhalation and oral TRVs, respectively. Those compounds that make up 99% of the emission profile's cumulative toxic potency are shaded.

Table 84-1: Toxic Potency Screen Using Inhalation TRVs

Compound	Annual Emissions (g/sec) (A)	TRV (ug/m^3) (B)	Toxic Potency (A÷B)	Relative Potency	Cumulative Potency
Acrolein	2.31E-03	0.02	1.15E-01	79.8%	79.8%
Formaldehyde	1.95E-02	0.77	2.53E-02	17.5%	97.3%
Acetaldehyde	2.72E-02	17.2	1.58E-03	1.1%	98.4%
Benzene	1.97E-03	1.3	1.52E-03	1.0%	99.5%
1,3 Butadiene	2.00E-04	0.3	6.67E-04	0.5%	99.9%
Xylenes	3.47E-03	100	3.47E-05	0.0%	100.0%
Aldehydes	4.55E-02	1700	2.68E-05	0.0%	100.0%
Pentane	1.44E-02	700	2.06E-05	0.0%	100.0%
Naphthalene	3.74E-05	3	1.25E-05	0.0%	100.0%
Toluene	4.80E-03	5000	9.61E-07	0.0%	100.0%
Benzo(a)pyrene	2.37E-07	0.32	7.39E-07	0.0%	100.0%
Ethylene	5.52E-03	8200	6.73E-07	0.0%	100.0%
Ethylbenzene	3.15E-04	1000	3.15E-07	0.0%	100.0%
Fluoranthene	4.81E-07	6.4	7.52E-08	0.0%	100.0%
Benzo(b)fluoranthene	2.04E-07	3.2	6.38E-08	0.0%	100.0%
Benzo(k)fluoranthene	2.04E-07	6.4	3.19E-08	0.0%	100.0%
Chrysene	1.33E-07	10.7	1.25E-08	0.0%	100.0%
Benzo(a)anthracene	7.24E-07	64	1.13E-08	0.0%	100.0%
Benzo(ghi) perylene	1.67E-07	16	1.04E-08	0.0%	100.0%
Indeno(1,2,3-cd)pyrene	2.69E-08	3.2	8.40E-09	0.0%	100.0%
Acenaphthylene	8.20E-07	200	4.10E-09	0.0%	100.0%
Pyrene	7.51E-07	320	2.35E-09	0.0%	100.0%
Acenaphthene	4.35E-07	200	2.17E-09	0.0%	100.0%
Phenanthrene	1.23E-06	640	1.93E-09	0.0%	100.0%
Fluorene	8.98E-07	640	1.40E-09	0.0%	100.0%
Anthracene	6.68E-07	640	1.04E-09	0.0%	100.0%
TOTAL Toxic Potency			1.44E-01	100.0%	

Table 84-2: Toxic Potency Screen Using Oral TRVs

Compound	Annual Emissions (g/sec) (A)	TRV (ug/kg bw/day) (B)	Toxic Potency (A÷B)	Relative Potency	Cumulative Potency
Benzene	1.97E-03	0.0322	6.12E-02	92.4%	92.4%
Acrolein	2.31E-03	0.5	4.61E-03	7.0%	99.4%
Benzo(a)pyrene	2.37E-07	0.0014	1.69E-04	0.3%	99.6%
Formaldehyde	1.95E-02	200	9.74E-05	0.1%	99.8%
Toluene	4.80E-03	80	6.00E-05	0.1%	99.9%
Benzaldehyde	2.59E-03	100	2.59E-05	0.0%	99.9%
Xylenes	3.47E-03	200	1.73E-05	0.0%	99.9%
Fluoranthene	4.81E-07	0.028	1.72E-05	0.0%	99.9%
Benzo(b)fluoranthene	2.04E-07	0.014	1.46E-05	0.0%	100.0%
Benzo(k)fluoranthene	2.04E-07	0.028	7.29E-06	0.0%	100.0%
Ethylbenzene	3.15E-04	100	3.15E-06	0.0%	100.0%
Chrysene	1.33E-07	0.04666666	2.86E-06	0.0%	100.0%
Benzo(a)anthracene	7.24E-07	0.28	2.58E-06	0.0%	100.0%
Benzo(ghi) perylene	1.67E-07	0.07	2.38E-06	0.0%	100.0%
Indeno(1,2,3-cd)pyrene	2.69E-08	0.014	1.92E-06	0.0%	100.0%
Naphthalene	3.74E-05	20.0	1.87E-06	0.0%	100.0%
Pyrene	7.51E-07	1.4	5.36E-07	0.0%	100.0%
Phenanthrene	1.23E-06	2.8	4.41E-07	0.0%	100.0%
Fluorene	8.98E-07	2.8	3.21E-07	0.0%	100.0%
Anthracene	6.68E-07	2.8	2.39E-07	0.0%	100.0%
Acenaphthene group	1.26E-06	40	3.14E-08	0.0%	100.0%
Acetaldehyde	2.72E-02	n/a	0.00E+00	0.0%	100.0%
Aldehydes	4.29E-02	n/a	0.00E+00	0.0%	100.0%
1,3 Butadiene	2.00E-04	n/a	0.00E+00	0.0%	100.0%
Ethylene	5.52E-03	n/a	0.00E+00	0.0%	100.0%
Pentane	1.44E-02	n/a	0.00E+00	0.0%	100.0%
TOTAL Toxic Potency			6.63E-02	100.0%	

According to the toxic potency screening, the following compounds constitute 99% of the emission profile's cumulative potency:

- Acetaldehyde
- Acrolein
- Benzene
- Formaldehyde

In light of this, ground-level air concentrations will be modelled for the following additional chemicals of potential concern:

- Acetaldehyde
- Acrolein
- Benzene
- Formaldehyde

The results of the air quality modelling will then be used to determine the potential risk to human health. Alberta Sulphur Terminals plans to describe the health risks for these four compounds in a separate report to Alberta Health and Wellness.

85. ***Volume IIA, Section 4.4.3, Page 4-8.*** *AST states "elemental sulphur was not assessed because Climate and Air Quality (see Volume IIA, Section 2: Climate and Air Quality) concluded elemental sulphur deposition would occur at a maximum predicted rate of 1.1 kg/ha/y within the Site boundary, which is below the deposition values that would impact crops or vegetable produce." Estimated deposition of sulphur particulates (elemental sulphur and sulphate compounds) was stated to be approximately 1.1 kg/ha/y. Inadvertent exposure to fugitive sulphur-containing dust particles off site can not be dismissed by simply stating the maximum predicted deposition of dust at the study boundary and consequently concluding that sulphur-containing dust particles will remain on site.*

Volume IIB, Executive Summary, Page 1-viii. AST states "a potential cumulative effect on aquatic resources was identified relating to dust deposition and air emissions interacting with sodium chlorate. Sulphur emissions have the potential to acidify surface waters in the vicinity of the Canexus sodium chlorate plant. Sodium chlorate forms chlorine dioxide, a disinfectant, in acid aqueous reaction. Chlorine dioxide is a gas that absorbs readily into water but is unstable and typically converts to chlorite. Chlorine dioxide has been found to be moderately toxic to fish (0.21 mg/L) but chlorite has been found to be only slightly toxic to fish (3.3 mg/L). This impact is predicted to be unlikely to occur given the buffering capacity of the soils."

The TOR are required AST to "provide information on samples of selected species of vegetation known to be consumed by humans." AST responded that no data were incorporated into the HHRA as the COPCs are not anticipated to bioaccumulate due to their physico-chemical characteristics. The sulphur-containing fugitive dust does necessarily have to bioaccumulate in

vegetation to represent a risk. Accidental or inadvertent ingestion of these particles by humans can result from ingestion of food materials to which particles adhere.

In subsection 4.4.2.4, AST considered soil to be unaffected and therefore exposure via soil contact, ingestion or inhalation was not assessed.

a) *Explain the statement "which is below the deposition values that would impact crops or vegetable produce". What deposition values would be required to impact crops?*

b) *Discuss the use of maximum average predicted annual deposition of sulphur and whether this is considered to be a worst-case scenario.*

c) *Address human health impacts as a result of deposition of sulphur particulates (element sulphur and sulphate compounds) on crops, vegetation and soil via ingestion and soil particles via inhalation and dermal exposures. Update the HHRA, including a multi-media assessment.*

A. The predicted deposition rate is well below deposition levels reported in literature that impact vegetation; see Volume IIC, Sec 3.5.2.2 of the EIA and SIR 8 for additional information.

B. The maximum average predicted annual deposition of sulphur is the Application Case, predicted sulphur deposition, and considered the maximum rate of deposition. From the perspective of normal operating conditions this would be considered the worst case scenario. This deposition rate is very low compared to injury threshold values for plants.

C. Contrary to its derivative forms such as SO_2 and H_2S, elemental sulphur generally is not considered to be toxic (Haas 2006). Sulphur is part of the amino acids methionine and cysteine, making it an essential dietary requirement for humans.

   A comprehensive search of the published scientific literature was completed to identify any relevant health effects information (i.e., toxicity studies) pertaining to sulphur. The following publicly available databases were searched.

   - Agency for Toxic Substances and Disease Registry
   - Carcinogenic Potency Database
   - Hazardous Substances Data Bank
   - International Programme on Chemical Safety
   - National Toxicology Program
   - Office of Environmental Health Hazard Assessment
   - Registry of Toxic Effects of Chemical Substances
   - Toxicological Literature On-line
   - U.S. National Library of Medicine
   - World Health Organization

Sufficient health effects data were not revealed for the development of provisional acute or chronic exposure limits for sulphur.

The deposition rate of sulphur predicted for the Project is below typical sulphur fertilizer rates for agricultural purposes and is not anticipated to cause vegetation, soil or human health impacts. Professional judgment supports the original decision to exclude these exposure pathways and not conduct a multi-media assessment.

Sulphur is absorbed by plants as a key nutrient and does not accumulate in plants in a toxic form. Hence there is no impact to food quality that potentially results in a toxic response in humans.

As described in Section 2.6.10 (Volume IIC), any changes to agricultural soils will be detected by the proposed periodic soil monitoring program. These changes are reversible through soil treatments such as lime application.

86. ***Volume IIA, Section 4.5.1, Page 4-9.***

a) *Review the H_2S acute and chronic limits, and include a table listing all relevant exposure limits (from the US EPA, Health Canada, ATSDR, Cal EPA etc.) for comparative purposes. If a less stringent exposure limit is employed, provide a rationale with citations to support the use of an alternate value. If a rationale cannot be provided, update the HHRA using the most stringent exposure limits.*

b) *Provide an odour assessment for H_2S and any other chemical that might be emitted from the Project that has a potential to produce odours.*

A. Table 86-1 below outlines the published acute limits for hydrogen sulphide.

Table 86-1: Acute Inhalation Exposure Limits for Hydrogen Sulphide

Regulatory Agency	Value (μg/m^3)	Averaging Time	Source
AENV	14 4	1-hour 24-hour	AENV (2005)
ATSDR	98	1-hour	ATSDR (2006a)
OEHHA	42	1-hour	OEHHA (2000)
OMOE	30	24-hour	OMOE (2005)
WHO	150	24-hour	WHO (2000)

Alberta Environment (AENV 2005) provides 1-hour and 24-hour Ambient Air Quality Objectives (AAQO) for hydrogen sulphide of 14 μg/m^3 and 4 μg/m^3, respectively. As well, the Ontario Ministry of Environment (OMOE 2005) recommends a 24-hour Ambient Air Quality Criteria (AAQC) of 30 μg/m^3. All of these guidelines were odour-based rather than health-based, and thus were not used in the acute effects assessment for hydrogen sulphide.

California's Office of Environmental Health Hazard Assessment (OEHHA 2000) provides an acute Reference Exposure Level (REL) of 42 µg/m^3 based on physiological responses to odour, including headache and nausea. Sixteen individuals were exposed to increasing concentrations of hydrogen sulphide until their odour threshold was reached. The Lowest Observable Adverse Effect Level was based on the range of odour thresholds of 16.8 to 97 µg/m^3 that was identified among the individuals. The geometric mean of the odour thresholds (42 µg/m^3) was used to develop the acute REL. It is likely that the symptoms reported are not the result of direct systemic toxicity, but instead represent physiological responses associated with odour. On this basis, the OEHHA acute REL for hydrogen sulphide was not used in the acute effects assessment.

The ATSDR provides an acute inhalation Minimum Risk Level (MRL) for hydrogen sulphide of 98 µg/m^3 (ATSDR 2006a,b). This MRL was developed based on a LOAEL of 2,800 µg/m^3 for changes in airway resistance and specific airway conductance in excess of 30% in two of the 10 individuals examined. The test subjects all had bronchial asthma requiring medication for 1-13 years, but none of the subjects had severe asthma. The subjects were exposed for 30 minutes and their respiratory function in response to a histamine challenge was assessed prior to and following exposure. Although the two subjects showed changes in airway resistance and specific airway conductance, no statistically significant alterations in lung function were observed at this concentration. The ATSDR (2006b) applied a combined uncertainty factor of 30 to account for the use of a minimal LOAEL (3-fold), interspecies differences (3-fold), and the lack of studies in children (3-fold). This acute MRL of 98 µg/m^3 was used as a 1-hour exposure limit in the acute effects assessment for hydrogen sulphide.

Table 86-2 outlines the published chronic limits for hydrogen sulphide.

Table 86-2: Chronic Inhalation Exposure Limits for Hydrogen Sulphide

Regulatory Agency	Value (µg/m^3)	Type	Source
ATSDR	--	--	ATSDR (2006a)
Health Canada	--	--	Health Canada (2004b,c)
OEHHA	10	RfC	OEHHA 2005
RIVM	--	--	RIVM (2001)
US EPA	2	RfC	US EPA (2003)
WHO	--	--	WHO (2000)

Note:
-- = not available.

The OEHHA reported a 90-day inhalation study in mice (10 or 12 mice per group) exposed to 0, 10.1, 30.5, or 80 ppm (0, 14.1, 42.7, or 112 mg/m^3, respectively) hydrogen sulphide for 6 hours/day, 5 days/week (CIIT, 1983). Neurological function was measured by tests for posture, gait, facial muscle tone, and reflexes. The only exposure-related histological lesion was inflammation of the nasal mucosa of the anterior segment of the

noses of mice exposed to 80 ppm (112 mg/m^3) hydrogen sulphide. Weight loss was also observed in the mice exposed to 80 ppm. The 80 ppm (112 mg/m^3) was considered the LOAEL, and 30.5 ppm (42.5 mg/m^3) level was considered the No-Observable-Adverse-Effect-Level (NOAEL) for histological changes in the nasal mucosa.

The US EPA has developed a reference concentration (RfC) of 2 µg/m^3 for nasal lesions of the olfactory mucosa (US EPA 2003). This RfC is based on a NOAEL of 13.9 mg/m^3 for olfactory loss in adult male CD rats following inhalation exposure to hydrogen sulphide for six hours per day, seven days per week for 10 weeks. The NOAEL was adjusted for intermittent exposure (6 hours/24 hours) to a concentration of 3.48 mg/m^3. The adjusted NOAEL was converted to a Human Equivalent Concentration (HEC) using the Regional Gas Dosimetry Ratio (RGDR) methodology.

$$RGDR_{ET} = \frac{(V_E/SA_{ET})_A}{(V_E/SA_{ET})_H}$$

$$RGDR_{ET} = \frac{0.19 \text{ litres/minute}/15 \text{ cm}^2}{13.8 \text{ litres/minute}/200 \text{ cm}^2}$$

Where:

$RGDR_{ET}$ = regional gas dosimetry ratio in the extrathoracic region

V_E = minute volume in rats (VE)A or humans (VE)H

SAET = extrathoracic surface area in rats $(SA_{ET})_A$ or humans $(SA_{ET})_H$

The $NOAEL_{ADJ}$ was then multiplied by the $RGDR_{ET}$ of 0.18 to yield a $NOAEL_{HEC}$ of 0.64 mg/m^3, as follows:

$$NOAEL_{HEC} = NOAEL_{ADJ} \times RGDR_{ET}$$

$$NOAEL_{HEC} = 3.48 \text{ mg/m}^3 \times 0.18$$

Finally, an uncertainty factor of 300 was applied to the $NOAEL_{HEC}$ to account for intra-species variability (10-fold), interspecies extrapolation (3-fold), and for subchronic exposure (10-fold). A 3-fold uncertainty factor was used instead of the 10-fold default value for extrapolation from rats to humans because the calculation of a HEC addresses one of the two areas of uncertainty encompassed in an interspecies uncertainty factor. The HEC adjustment addresses the pharmacokinetic component of the extrapolation factor, leaving the pharmacodynamic area of uncertainty. The US EPA RfC of 2 µg/m3 was selected as the chronic inhalation limit for hydrogen sulphide.

For both H2S acute and chronic exposure limits, rationale has been provided indicating that the most stringent scientifically defensible limit has been used in this assessment.

B. The primary objective of an odour assessment is to evaluate the potential odours associated with a facility's emissions. According to the emission profile for the Alberta Sulphur Terminals Project, the chemical anticipated to exhibit the greatest odour potential is hydrogen sulphide. There were no other reduced sulphur compounds identified by the Air Quality Team, suggesting that the primary concern with respect to odour would be limited to hydrogen sulphide emissions.

The odour assessment focused on short term odours associated with emissions from the Project in combination with existing or approved developments in the region (i.e., Baseline Case), as well as with proposed future developments in the area (i.e., Cumulative Effects Case).

The potential for Project emissions to contribute to odours was assessed by comparing either 3-minute or 1-h chemical concentrations with established mean odour thresholds. Three-minute peak concentrations were calculated from the predicted 1-h ground-level air concentrations as follows:

$$C_{3\text{-min}} = C_{1\text{-hr}} \times [(60 \text{ minutes}/3 \text{ minutes})]^{0.2}$$

Where:

$C_{3\text{-min}}$ = predicted 3-minute peak concentration
$C_{1\text{-hr}}$ = predicted 1-h concentration
0.2 = exponent for the 3-minute multiplier

The exponent (*i.e.*, 0.2) for the 3-minute multiplier used for this assessment is based on neutral atmospheric conditions (OMOE 1996; Duffee et al. 1991).

As odours are commonly observed over very short time periods, 3-minute peak concentrations were estimated for most of the COPCs. The potential for COPCs to contribute to nuisance odours was assessed as follows:

- The maximum peak air concentrations were predicted or measured. Background concentrations were measured at Lamont and Fort Saskatchewan.
- The 3-minute or 1-h air concentrations were compared to the corresponding odour threshold for each assessment case (i.e., Baseline Case, Application Case and CEA Case), as well as for the background case.

As the 3-minute peak concentrations were predicted using 1-h ground-level air concentrations, the COPC levels that might be encountered under most circumstances may be exaggerated, resulting in conservative odour estimates.

Odour thresholds for the COPCs were obtained from review articles (Amoore and Hautala 1983; van Gemert 1999) and summarized in Table 86-3. The lower the odour threshold, the more odorous the chemical, with the lower end of the range representing the "minimum" odour threshold.

Table 86-3: Summary of Odour Characteristics and Odour Thresholds

Chemical[1]	Odour Character[2]	Odour Threshold (µg/m^3)		Reference
		Mean	Range	
H_2S	Rotten eggs	14	0.06 to 5,000	AENV 2005; van Gemert 1999
SO_2	Metallic taste, sharp irritating	2,880	870 to 21,000	Amoore and Hautala 1983; van Gemert 1999
NO_2	Bleach	400	110 to <9,400	AENV 2005; van Gemert 1999
Carbon monoxide	Odourless	115,000,000	--	Amoore and Hautala 1983

Notes:
[1]The odour thresholds for H_2S, and NO_2 are based on odour-based regulatory air quality guidelines for a 1-hour averaging period.
[2]Sourced from AIHA (1989).
-- no information available.

Odour ratios (ORs) were calculated using the equation below to determine the ratio of the highest short-term air concentration to the average odour threshold for a substance.

$$\text{Odour Ratio (OR)} = \frac{\text{Peak Air Concentration (3-min or 1h)}}{\text{Mean Odour Threshold (3-min or 1h)}}$$

Odour ratios were interpreted as follows:

- OR ≤1 Signifies that the maximum predicted air concentration is less than or equal to the mean odour threshold and odours associated with that COPC are unlikely to occur.
- OR >1 Signifies that there is some potential for individuals to detect odours associated with that COPC. The significance of these results must be further evaluated and balanced against the conservatism incorporated in the odour assessment.

The results are based on maximum predicted 1-h air concentrations or on 3-minute “peak” air concentrations. Odour assessments are typically based on peak concentrations, but the Alberta Environment odour-based air quality objectives and criteria are based on hourly averaging times; thus, the odour thresholds for these COPCs were compared against their predicted maximum 1-h air concentrations.

Maximum background and predicted concentrations were used for assessing odour risks in the study area. For limits derived from Alberta Environment (2005), including H_2S and NO_2, air concentrations were not adjusted for 3-minute exposure. Measured and predicted carbon monoxide and SO_2 air concentrations were adjusted for 3-minute exposure. Table 86-4 summarizes the air concentrations used in the odour assessment.

Table 86-4: Air Concentrations Used in the Odour Assessment

	Background (µg/m^3)	Baseline (µg/m^3)	Application (µg/m^3)	CEA (µg/m^3)
H_2S	8	8	10	10
SO_2	218	218	253	253
NO_2	102	125.2	311	311
CO	10,559	10,595	10,992	10,992

Notes:
Air concentrations adjusted to 3-minute concentrations where applicable.
Baseline, Application and CEA values include background air concentrations.

The odour ratios associated with these air concentrations are presented in Table 86-5 below.

Table 86-5: Odour Ratios at the Maximum Point of Impingement

	Odour Ratios			
	Background	Baseline	Application	CEA
H_2S	0.6	0.6	0.7	0.7
SO_2	0.08	0.08	0.09	0.09
NO_2	0.3	0.3	0.8	0.8
CO	0.00009	0.00009	0.0001	0.0001

Note:
Odour Ratios are based on mean odour thresholds.

As shown, peak air concentrations are not expected to exceed mean odour thresholds at the locations where the maximum air concentrations are expected to occur. When compared to mean odour thresholds, the majority of people in the area are not expected to detect any odours associated with the Project's emissions.

In SIR 66D more information is provided regarding H_2S emissions. The maximum hourly predicted H_2S concentration at the Property boundary is 2.2 µg/m^3 which is below the background concentration used in the odour assessment. Atmospheric dispersion processes will quickly dilute the emissions to less than this value. A detailed description pertaining to background concentrations is provided in SIR 70.

87. ***Volume IIA, Section 4.6.1, Page 4-10.*** *For the description of the assessment cases AST describes the three development case scenarios with reference to the Climate and Air Quality LSA.*

    a) *To evaluate regional human health impacts, complete an HHRA using the RSA for each development scenario.*

    A. The HHRA attempted to capture a reasonable "worst-case scenario" with respect to the potential health risks associated with the Project's emissions. The presentation of the health risks at the maximum points of impingement represents this type of scenario.

    The results of the EIA indicate that predicted impacts are local in geographic extent for acute and chronic human health risks. Additionally, predicted impacts related to chemicals of potential concern in Climate and Air Quality, Groundwater Quality, Surface Water Quality, Vegetation and Soils are local in geographic extent. Based on the results of these assessments, professional judgment supports the original decision to limit the HHRA to the local study area.

88. ***Volume IIA, Section 4.6.3, Table 4.6-2, Page 4-12.*** *Table 4.6-2 lists the measured background air concentrations used in the assessment.*

    a) *Provide the rationale for the selection of the Lamont data.*

    b) *Clarify if the Lamont data was typically higher than the Fort Saskatchewan data. If the Lamont data was not higher than the Fort Saskatchewan data explain why the Fort Saskatchewan data was not used.*

    A. The Lamont monitoring station is much closer to the study area than is the Fort Saskatchewan monitoring station.` The Lamont station and The Project are both located in rural areas. The Fort Saskatchewan station is located in an urban environment.

    The Lamont data is considered for the above reasons to be more representative of air quality conditions within the LSA.

    B. Air quality data with respect to H_2S, $PM_{2.5}$ and SO_2 were generally similar at the Lamont and Fort Saskatchewan monitoring stations.

    Values of NO_2 were larger at Fort Saskatchewan than at Lamont. This is because of greater vehicle traffic in the urban as opposed to the rural area. The larger NO_2 data observed at Fort Saskatchewan would therefore not be representative of the rural region surrounding the Project.

89. ***Volume IIA, Section 4.8.1, Table 4.8-1, Page 4-14.*** *In Table 4.8-1 the concentration ratio for the 1-hour respiratory mixture was reported to be 1.2 for the Application and CEA cases.*

    a) *In order to understand cumulative impacts, discuss the potential health impacts from the predicted acute chemical exceedance in the region in total (i.e., characterize the respiratory mixture value of 1.2).*

A. A Concentration Ratio (CR) of 1.2 was predicted for the respiratory irritant mixture at the maximum point of impingement (MPOI) under the Application and CEA Case.

The HHRA assumed that there is an additive interaction between all respiratory irritant chemicals, so the predicted acute health risks associated with the respiratory irritants were summed. The respiratory tract irritant mixture includes:

- hydrogen sulphide;
- nitrogen dioxide, and
- sulphur dioxide.

It is important to note that the HHRA conservatively assumed that the maximum short-term air concentrations of these three compounds would be occurring at exactly the same time at exactly the same location. The actual likelihood of such an event occurring is considered improbable.

The primary contributors to the predicted risks for the respiratory irritant mixture are NO_2 (67%) and SO_2 (30%), which together represent approximately 97% of the mixture. However, the effect endpoints and the modes of action for these irritants differ. Nitrogen dioxide can be inhaled deeply into the lungs, acting as a deep-lung irritant, whereas SO_2 is more soluble in water and is readily absorbed through the upper respiratory tract, inducing increases in airway resistance higher up in the respiratory tract (Calabrese 1991). The dose-response relationships for these chemicals are somewhat independent in that the primary responses occur in different regions of the respiratory tract. As well, there is some degree of conservatism incorporated into the acute inhalation exposure limits for some of the respiratory tract irritants (e.g., sulphur dioxide).

The maximum predicted acute (1-hour) NO_2 air concentration of 209µg/m^3 is below effect levels reported to induce slight reduction in lung function and decreased lung capacity in sensitive individuals during exercise (375 to 940µg/m^3), and far below levels known to induce potential difficulties breathing in sensitive individuals due to airway resistance (greater than 1,800 µg/m^3). Please refer to Section 1.3 in Appendix I ("Toxicological Profiles") of Volume IIA, Section 4 for additional information on the potential effects of NO_2 at varying air concentrations.

Lastly, the majority of exposure to SO_2 will be from background concentrations (120 µg/m^3), representing 86% of the SO_2-related risk. In addition, the maximum predicted acute (1-hour) SO_2 air concentration of 19.4 µg/m^3 for the region is well below those concentrations expected to induce a reaction from sensitive individuals (Table I-3 in Volume IIA, Section 4, Appendix I).

Highlights are listed below:

- At sufficiently high concentrations, SO2 acts as an upper respiratory tract irritant. At lower concentrations, it is effectively "scrubbed" by the nose. This scrubbing action effectively prevents the movement of SO2 further down the respiratory tract, thereby reducing any likelihood of bronchoconstriction and other signs of respiratory distress.

- Asthmatic individuals are known to be very sensitive to the irritant effects of SO_2. Exercising asthmatics are especially sensitive. Sensitivity will vary depending on the severity of the asthmatic condition, the level of physical activity, and the pattern of breathing (i.e., oral vs. nasal).
- The majority of clinical evidence suggests that most individuals will not notice any response to short-term exposures to concentrations of SO_2 at or below 1,000 µg/m^3. This finding applies even to exercising individuals with mild asthma.

The threshold of response among severe asthmatics appears to rest between 530 and 1,060 µg/m^3 based on responses observed among freely-breathing asthmatics engaged in moderate exercise.

For the reasons given, the predicted concentration ratio of 1.2 is not expected to translate into measurable respiratory effects.

90. ***Volume IIA, Section 4.8, Pages 4-13 to 4-15.***

a) *Identify whether a human health risk assessment was completed for the construction phase of the expansion, if so provide the results. If not, discuss potential health impacts and provide evidence in support of the conclusions.*

A. The HHRA was completed for full scale operations at 6,000 tonnes per day production. A separate HHRA was not conducted for the construction phase of the expansion as it is not anticipated that potential impacts arising during the expansion will be greater than those assessed for operation of the full scale Project. Potential for public impacts to human health during the construction phase would be associated with increased traffic. Traffic was evaluated and traffic impacts were concluded to be acceptable for both the construction and operating phases.

91. ***Volume IIA, Section 4, Pages 4-1 to 4-17****. AST did not provide an assessment of $PM_{2.5}$ exposure using the Health Canada SUM method.*

a) *Provide the required assessment.*

Predicted acute and chronic inhalation Risk Quotients (RQs) for $PM_{2.5}$ were less than 1.0 at the maximum point of impingement for all assessment cases. Acute health risks were based on the Canada-Wide Standard (CWS) of 30 µg/m^3 (98th percentile) (CCME 2000).

As requested, the assessment of health risks based on the Health Canada (1999) SUM15 method is provided for the hypothetical location at which maximum $PM_{2.5}$ concentrations were predicted to exceed 15 µg/m^3.

The type of information that is required to calculate the SUM15 health risks includes:

- cumulative air concentrations of $PM_{2.5}$: the one-year sum (i.e., 365 days) of 24-hour $PM_{2.5}$ concentrations that exceed the Health Canada reference level of 15 µg/m^3 (i.e., ∑[24-hour $PM_{2.5}$ air concentration – 15 µg/m^3]);

- relative risk estimates for mortality, Respiratory Hospital Admissions (RHA) and Cardiovascular Hospital Admissions (CHA); and
- baseline mortality, RHA and CHA incidence rates.

Average 24-hour concentrations of $PM_{2.5}$ collected from 2002 to 2005 were used for this assessment. A median background value of 5.3 $\mu g/m^3$ was added to each of the 24-hour average concentrations. This median background value was measured at the Lamont air monitoring station under the AST Project plus Canexus Sodium Chlorate Plant assessment scenario (AST 2007). The study included three monitoring areas, including Fort Saskatchewan and Elk Island, but identified Lamont as having the highest $PM_{2.5}$ concentrations of the three areas. Table 91-1 outlines the cumulative concentrations that were determined for this location from 2002 to 2005.

Table 91-1: Cumulative Daily $PM_{2.5}$ Air Concentrations Exceeding Health Canada's Reference Level of 15 µg/m³ from 2002 to 2005

Location	2002	2003	2004	2005
Lamont, AB	0	0	0	0

As shown, none of the cumulative $PM_{2.5}$ concentrations (i.e., background plus predicted concentrations) exceeded the Health Canada reference level of 15 $\mu g/m^3$. As a result, no changes to the baseline mortality and morbidity rates are predicted according to the Health Canada SUM15 method. Therefore, the Project's $PM_{2.5}$ emissions are not expected to increase the mortality and morbidity rates in the Lamont region.

92. ***Volume IIB, Executive Summary, Page 2-i.*** *AST states, "The primary aquifer is a sandstone interval located in the upper bedrock zone at a maximum depth of approximately 15 metres below ground surface (mbgs). This zone appears to be used as a domestic and potable water supply for most rural residences in the vicinity of the Site." There may be some uncertainty with respect to the assessment of effects of withdrawal and the potential for contamination to the domestic water wells located downgradient of the Project. Specifically, the groundwater systems identified below the PDA are potentially hydraulically connected with up to five registered wells located downgradient of the project.*

a) *What mitigation measures does AST propose to prevent contamination of these water wells?*

b) *When would the management plan be triggered should contamination be detected?*

c) *What contingency measures does AST have in place should contamination occur?*

A. The mitigation measures that AST proposes to prevent contamination of these water wells are described in Volume IIB, Section 2.7 and 2.8. The mitigation program associated with the protection of groundwater can be summarized succinctly as follows. All chemicals, products and wastes associated with the Project that could otherwise impact groundwater quality will be stored and handled within contained facilities that include leak detection capability and secondary containment. Any spills that occur outside of these areas, and any leaks that occur within these areas, will be quickly addressed and remedied. Groundwater monitoring will be

completed on a regular basis to identify any adverse impacts to groundwater quality. Groundwater remediation will be implemented if, and when, these impacts are of such a degree that they put the aforementioned water supply wells at risk.

B. The management plan (or remediation plan as identified above) would be implemented whenever the groundwater impacts are of a sufficient degree to put the domestic water supply wells at risk. The degree of impact would typically be classified and defined in terms of scale and concentration. The potential for impact to the domestic supply well would then be determined using standard predictive methods for groundwater and contaminant flow, and by using the Canadian Drinking Water Quality Objectives as a reference.

C. As described in Volume IIB, Sections 2.7 and 2.8, typical groundwater remediation options include source removal, hydraulic containment, in situ remediation, and monitored natural attenuation. The appropriate remediation technique would be selected depending on the nature, extent, concentration and migration pattern of the contaminant(s) in question.

Assuming that all mitigation measures are implemented appropriately and given the buffering capability and low sensitivity of soil and groundwater on Site to acid deposition, it is anticipated that groundwater quality within the PDA and LSA will not be measurably affected by acid deposition arising out of normal operational activities.

Assuming that all mitigation measures are implemented appropriately, it is anticipated that the overall groundwater quality within the LSA during the Project lifetime will not be significantly affected by upset conditions during construction and operations. Although upset conditions and potential effects may occur sporadically during the Project lifetime, the geographical extent of these effects is likely local (within the LSA).

Based on the above assessments, the overall effect to groundwater during the Project lifetime is considered to be negative in direction, local in extent, low to moderate in magnitude, short term in duration, and reversible.

Uncertainty in the assessments arises from Project operation uncertainty, as well as, geologic uncertainty (i.e., groundwater velocities and recharge rates and the long-term aquifer response to water withdrawals). On balance, confidence in the groundwater quality Project effects assessments is high, given that Project effects are mostly limited to the PDA and LSA; areas that have been relatively well characterized by field investigations. The final impact rating is considered to be Class 3.

A summary of the residual effects assessments is provided in Table 2.11 1. The final impact ratings are considered to be Class 3, as only slight declines were predicted in the quantity or quality of relevant indicators during the life of the Project. The declines in the indicators are expected to propagate only slowly with time, and can, therefore, be adequately managed through the proposed bi-annual monitoring program. Ample response time is available for mitigation in the event that unacceptable impacts are observed. Groundwater levels should quickly recover to pre-development levels once groundwater withdrawal is discontinued. Resource levels should recover to baseline after closure of the Project.

Table 2.11-1: Final Impact Assessment Summary for Construction and Operation Phases

Issue	Direction	Magnitude	Geographic Extent	Duration	Reversibility	Confidence	Final Rating
Decreased water levels and flows	Negative	Negligible to low	Regional	Medium-term	Reversible	Moderate	Class 3
Interaction between groundwater and surface water	Negative	Negligible	Local	Medium-term	Reversible	Moderate	Class 3
Groundwater available to existing users	Negative	Low	Regional	Medium-term	Reversible	Moderate	Class 3
Potential effects to groundwater quality	Negative	Low to moderate	Local	Short-term	Reversible	High	Class 3

93. ***Volume IIB, Section 2.6, Page 2-32****. AST states, "The Project will use groundwater as a makeup source unless or until an adverse off Site effect becomes apparent through monitoring. At that point, either a bigger storage pond will be constructed and/or water may be obtained from an alternate source."*

a) *Explain AST's rationale for waiting until the need for groundwater or for potential effects to occur to build a larger storage pond.*

AST states that "The Project will use groundwater as a makeup source unless or until an adverse off Site effect becomes apparent through monitoring". A groundwater management plan should not only be triggered after contamination occurs, but should also have mechanisms in place to avoid contamination.

b) *Discuss the mechanisms that AST has developed in its management plan(s) to avoid adverse environmental effects for both surface and ground water.*

A. There are three primary reasons for waiting to build a bigger pond. (1) The Project will be constructed in phases, with the first stage of construction requiring only half the volume of water for cooling as the full development case. It is quite possible that the surface and groundwater sources will be sufficient to supply the water needs for the first stage of the Project. (2) The groundwater extraction can be confidently monitored to ensure that no adverse effect to other groundwater users occurs when groundwater extraction is taking place. (3) A make-up water supply is available through the local water supplier.

B. The primary mechanism that AST has developed in its management plan to avoid adverse environmental effects to surface water include collection, containment and reuse of all surface water runoff that occurs in areas of risk of impact. A surface water monitoring program is included in the management plan to confirm the effectiveness of the above. The primary

mechanisms to avoid quality impacts to groundwater are identified in the answer to SIR 92, above. The primary mechanisms to identify adverse impacts to water quantity are regular monitoring followed by provision of an alternate water source if adverse effects to water quantity are observed.

94. ***Volume IIB, Section 2.6.5, Page 2-39.*** *AST states, "a survey to verify water well use in the immediate vicinity of the Site will be conducted in conjunction with the long-term pumping test."*

    a) *Provide this information and update the HHRA accordingly to account for these receptors.*

    A. A survey to verify water well use was not conducted for the reasons provided in SIR 24. As discussed in SIR 81, groundwater is considered to be an inoperable pathway.

    Volume IIB, Section 2 presents the results of the Groundwater Quantity and Quality assessment. Additional results assessing groundwater quantity were submitted to AENV under separate cover following the completion of the long-term pumping test. Based on the results of these assessments, professional judgment supports the original decision to consider groundwater as an inoperable pathway in the HHRA. This conclusion is supported by the absence of predicted impact to groundwater quality, the reactive nature of sulphate (the COPC associated with sulphur management), the very low groundwater flow velocity, and the absence of significant hydraulic connection between the aquifer used for domestic water supply and the uppermost groundwater bearing zone.

95. ***Volume IIB, Section 2.7.4.1, Pages 2-41 to 2-43.*** *AST states that upset conditions (chemical spills, breach of surface water pond) "could result in a temporary negative effect to groundwater quality." With respect to construction effects on groundwater quality, AST states: "Assuming that all mitigation measures are implemented appropriately, it is anticipated that the overall groundwater quality within the LSA during the Project lifetime will not be significantly affected by upset conditions during construction and operations." An assessment was not provided to support these conclusions.*

    a) *Assess potential health impacts during upset conditions and abnormal emission events.*

    A. An assessment of potential impacts to groundwater quality and therefore the health of people that rely on that groundwater is reported in Section 2 of Volume IIB. Products and wastes (including stormwater) are stored in double lined facilities equipped with leak detection capabilities. Therefore, impact to groundwater quality related to these storage facilities is not anticipated. In the unlikely event of a spill, there is a risk that groundwater quality may be affected. The adverse effect to groundwater quality would be limited to a confined area, well within the Site boundaries, where groundwater is monitored and is not used for human consumption. Hence, there is no basis to anticipate human health related impacts associated with the consumption of groundwater.

96. ***Volume IIB, Section 4.5.1.3, Page 4-19****. AST states, "Dissolved arsenic concentrations exceeded the CCME guideline (0.005 mg/L) at six sampling locations during the June sampling round…However, an elevated dissolved arsenic concentration was also recorded in the June trip blank sample, therefore, these results are not considered representative and have been discredited." It is possible that the samples were correct and the blank happened to be*

contaminated. Furthermore, if the blank was used as a lab blank for analysis, this would have underestimated concentrations in the samples. Also, differences in arsenic concentrations could be due to seasonal or temporal effects, as values were higher in the June sampling period compared to the October round.

a) *Given the uncertainties, conduct an additional round of sampling and provide the results. If elevated concentrations are validated, discuss mitigation measures.*

Volume IIB, Section 4.5.1.4, Page 4-19 -4-20. As was the case for arsenic, in the case of hydrocarbons elevated concentrations were seen during the June sampling round however the values were discredited due to elevated concentrations in the blank sample. As noted in the question above, since the sampling rounds reflect different seasons, and the reason why the blank sample was contaminated is unclear, additional sampling is required prior to making conclusions regarding surface water quality in the area.

b) *Similar to a), conduct an additional round of sampling and provide the results. If elevated concentrations are validated, discuss mitigation measures.*

A. Additional surface water monitoring will be conducted prior to constructing the Project to further define baseline conditions. As this work is completed only to establish baseline conditions, mitigation measures are not required if elevated concentrations of arsenic persist in these samples. The measured concentrations of arsenic are very low and approach the Method Detection Limit (MDL) and Practical Quantitation Limit (PQL) for the laboratory method. Given the presence of arsenic detected in the blank, the reliability of these results is questionable.

B. Please see the answer to A above. It is our experience that toluene is a common laboratory artefact when testing for target hydrocarbon compounds.

97. ***Volume IIB**. Provide an assessment of predicted impacts to surface water quality in the study area associated with the Project and Cumulative effects. This is a required component of the application and could impact the conclusions of the HHRA.*

This assessment is provided as Volume IIB, Section 4 of the EIA. Given the general nature of the question, it is not possible to provide further elaboration or explanation.

"Results of Thermal Testing on Sodium chlorate, Sulphur and Oat Flour" Safety Management Services for HAZCO (SMS-1433-R1.1)."

98. ***Section 4.0, Page 5.** AST states "the risks associated with the presence of fugitive sulphur dust in the vicinity of the Canexus chlorate plant are similar to those associated with the presence of crop dust, assuming that these materials are present in similar proportions."*

a) *What will be the proportion of these materials under operating conditions?*

b) *Will there be an increased risk based on what is emitted from the operations?*

A. The amount of fugitive sulphur dust generated by the proposed Project is described in Volume IIA, Section 2. The underlying sulphur deposition drawing summarizes the results of this aspect of the air quality assessment. The baseline chlorate/sulphur reactivity test represents a

proportion of sulphur approximately equal to a 5 year depositional mass. Equal proportions of oat flour were tested as a quasi-reference point representing background conditions. We have not rigorously evaluated the amount of organic dust that may be present in the area during the harvesting period. However, our observations would suggest that the concentration of airborne organic matter generated by harvesting activities would greatly exceed that of elemental sulphur during operation of the Project.

B. In our opinion, the test results investigating the reactivity of sulphur with chlorate indicate that the risks posed by the predicted fugitive sulphur emissions are not significantly different from those posed by current conditions; hence, there is no increased risk of a vigorous reaction with sodium chlorate that occurs as a result of the Project.

99. ***Section 4.0, Page 5.*** *AST states "Based on the results of these tests, there is an optimum ratio of sodium chlorate to sulphur or oat flour that would create a potentially explosive mixture. Mixtures of 70% sodium chlorate and 30% sulphur or oat flour are potentially explosive."*

a) *What is the likelihood that this mixture would occur?*

A. There is essentially no possibility of the 70% sodium chlorate and 30% sulphur mixture occurring as a result of the emissions of fugitive sulphur dust from the Project.

1.7 EMERGENCY RESPONSE PLAN

100. ***Volume I, Appendix IV, Section 8, Page IV-15.*** *AST states "The Emergency Response Plan, contained in Appendix V of Volume I was completed to evaluate emergency scenarios with the goal of establishing what individuals could be at risk as a result of an emergency and to what degree those individuals may be put at risk". A hazard and risk assessment is a key element in defining what potential emergency situations AST may have to deal with. The emergency response plan should address both general and specific emergency response guidelines to deal with these potential events.*

a) *If a hazard and risk assessment has been conducted for the proposed facility, provide the results and comment on the probability of an event or hazard occurring and the potential impacts.*

A. A risk assessment was previously completed on behalf of AST, a copy of which is attached (Attachment 7). The Emergency Response Plan was designed to address the emergency situations that are envisaged. A probabilistic analysis of these risks has not been completed.

101. ***Volume I, Appendix IV, Section 8, Page IV-15.*** *AST states "The Emergency Response Plan, contained in Appendix V of Volume I was completed to prepare for emergencies and put in place the necessary personnel, training and equipment to appropriately respond to emergency situations that can be reasonably anticipated."*

a) *What is the structure of the emergency response organization that is proposed for the facility and what is the role of the corporate Emergency Operations Center (EOC) in dealing with an emergency situation at the proposed site?*

b) *Appendix V does not provide a consolidated list of emergency response equipment. What equipment will be available to enable site responders to deal with emergency situations?*

A. The emergency response organization of the facility will mirror the facility management organization. A Lead Operator will be assigned to be responsible for facility operations during a given shift. That Lead Operator will be responsible for emergency response coordination and execution on site. A second operator will be assigned to take charge of the facility (operations as well as in emergency conditions) if the Lead Operator is not capable of responding. The role of a corporate centre would be to assist in communicating with local emergency response capability in the event of an emergency.

B. A comprehensive list of emergency response equipment will be prepared as part of the detailed design of the facility, and would be incorporated into the ERP at that time. A list of fire fighting resources and equipment available on site is provided in SIR 108.

102. ***Volume I, Appendix V, Section 1, Page V-2.*** *In reference to the NR CAER Emergency Response Guide, CAN/CSA-Z731-03, and EUB Directive 071 (Dec. 06), AST states "these guides were used to establish best practices for this facility and do not constitute regulatory requirements."*

a) *What criteria or selection process was used to determine what elements from each guide would contribute to establishing these best practices?*

b) *AST states "This Preliminary Emergency Response Plan…meets all applicable regulatory requirements." What are the applicable regulatory requirements?*

A. The authors of the Emergency Response Plan used their judgement and knowledge of the sulphur forming and shipping facilities in Alberta when utilizing these guides as references. The intent was to develop an ERP that complies with the requirements of Directive 071.

B. To the best of our knowledge there are no NRCB Directives regarding emergency response. However, it is recognized that EUB guidance documents and directives are often applied by the NRCB where the NRCB has not developed their own reference documents. For that reason, the Preliminary Emergency Response Plan was designed having regard to the requirements of Directive 071.

103. ***Volume I, Appendix V, Section 5.3.1.2, Page V-12.***

a) *Provide AST's definitions for "hot" and "warm" zones.*

A. 'Hot' and 'warm' zones would correspond to areas where SO_2 concentrations may exceed occupational exposure limits and alarm levels, respectively.

104. **Volume I, Appendix V, Section 5.3.1.3.4, Page V-14.** AST states "*The emergency rescue team consists of three individuals, including the pre-designated team leader…*"

a) *How does the emergency rescue team fit into the overall emergency response organization? Include a discussion on how they will work with the two operations personnel identified in Section 4.2.*

b) *What emergency training, qualifications and certifications will members of the emergency rescue team be required to have?*

A. As stated in the response to SIR 101, the organization of the emergency response team mirrors the organization for the facility operation. If rescue is required, an emergency rescue team will be identified by the Lead Operator, and would likely comprise operators that are working at the facility at the time. One of the individuals will be identified as the emergency rescue team leader for the purpose of completing the rescue. The Lead Operator may or may not be a member of the Emergency Rescue Team.

B. Standard emergency response preparation training and current certification would include the following:

a. Advanced First Aid;

b. Industrial Fire Fighter Level #2;

c. H_2S Alive; and

d. WHMIS.

105. ***Volume I, Appendix V, Section 5.3.1.3.6, Page V-16.***

a) *What are the criteria for personnel to evacuate the Site? To Shelter In Place?*

b) *What process is followed and what resources are used to evacuate personnel from the Site? Where do they get evacuated to?*

A. The criteria for evacuation to the Muster Station are the same as the alarm levels and alarms. Safe evacuation to an alternate muster station would occur if safe evacuation to the assigned Muster Station were not possible. Because of the risk of poison gas, Shelter In Place would not be considered in emergency conditions unless a SCBA were available and fully donned.

B. Evacuation from the Site would only be considered under emergency situations that put the safety of site personnel at direct risk. It is noted that breathing apparatus will be available to all site workers. Work vehicles that would be parked adjacent to the Control Room (Muster Station) would be used for evacuation from the property. Evacuation, should it be deemed necessary, would be in the upwind direction.

106. ***Volume I, Appendix V, Section 7, Page V-18.*** *AST provides a preliminary emergency response plan for hazardous spills.*

a) *Discuss the response time by AST should an incident occur.*

A. Note that potentially hazardous materials would be limited to those noted in the Project Description and would potentially include fuel, lubricants, dust suppressants, and lime. As these substances are typically handled manually when at risk of being spilled, recognition of the spill will be immediate. Response to the spill is expected to occur in less than 10 minutes. Some time may be required to ensure that safe working procedures (e.g., MSDS Sheets) are reviewed prior to responding, and to ensure that appropriate personal protective equipment is worn.

107. **Volume I, Section 7.3.1, Page V-19.** AST states "*Mutual Aid responders will be trained to work with AST staff when dealing with molten sulphur…*"

a) *What training is required to be able to work with molten sulphur?*

A. Specific training for formal response personnel would be the same as that required to work at the facility, and is described in the response to SIR 104. Section 7.3 of Appendix V of Volume I deals with molten sulphur spills. It is noted that sulphur quickly solidifies when spilled in an open air environment, and when exposed to ambient temperatures. Hence, liquid sulphur spills are typically not difficult to respond to.

108. ***Volume I, Appendix V, Section 8, Page V-20.***

a) *What fire fighting resources and equipment will be available on Site?*

b) *What certification does "basic fire fighting" equate to?*

A. Fire fighting equipment includes: automatic spray systems in the forming areas, numerous 30 pound portable fire extinguishers in all buildings and work areas, 2 - 350 pound portable fire extinguishers in the pastille stockpile area, 1 – 350 pound portable fire extinguisher at the sulphur receiving area, and a manually actuated portable misting system sourced from the water pond. Breathing apparatus would also be available for all site workers.

B. Site workers would be certified to Industrial Fire Fighter Level #2.

109. ***Volume I, Appendix V, Section 10, Page V-31.*** *AST states "In the case of a large-scale fire or air quality alarm, residents within a high-risk area are automatically contacted via the Automated Dial-Out Program managed by NR CAER. They receive information pertaining to the nature of the emergency and the appropriate safety instructions. People who do not have transportation or cannot follow the instructions will be asked to contact the local authority for assistance."*

a) *What is considered a high risk area? Who determines what the high risk area is and how is it determined?*

b) *Who will provide the warning message and activate the Automated Dial-Out Program that is available by NR CAER?*

c) *Has the local authority been advised of their role in providing assistance to those who do not have transportation or cannot follow the instructions?*

d) *How will residents and the general public in the area be notified of this procedure?*

A. The high risk area was determined by air dispersion modelling and is referred to as the Worst Case Scenario in the documents.

B. The Lead Operator at the facility will provide the warning message and activate the Automated Dial-Out Program that is made available by NR CAER.

C. The Local Emergency Response authorities will be notified and involved as stated in the Emergency Response Plan (Level II Emergency). The program for responding to individuals

who do not otherwise have transportation will be determined in greater detail as part of the overall emergency response planning implemented through the NR CAER program.

D. Residents and the general public in this area will be notified of this procedure and will be engaged in establishing the procedure.

110. ***Volume I, Appendix V, Attachment V-2, Page V-33.*** *To be able to effectively implement the requirements of the emergency response plan a defined training and exercise program is necessary.*

a) *What type of training will be provided to responders?*

b) *How often will training and exercises occur?*

c) *Who is responsible for organizing training and exercises?*

A. Responders should have the same training as facility operators, as is described in the response to SIR 104. Responders will also be trained in the layout, operations and risks associated with the proposed Project.

B. Training for certifications will be implemented in accordance with the schedules required to maintain those certifications. Exercises of emergency response procedures will be undertaken for each crew at least annually.

C. The Manager of the facility is responsible for organizing the training and exercises.

1.8 ENVIRONMENTAL RISK

"Results of Thermal Testing on Sodium chlorate, Sulphur and Oat Flour" Safety Management Services for HAZCO (SMS-1433-R1.1).

111. ***Section 2.1, Page 2.*** *The mixtures used in the reactivity tests were formulated based on the "anticipated mixture proportions resulting from the Maximum Yearly Cumulative Deposition of elemental sulphur over a 5 year period as reported by DM Leahey & Associates (2007)." AST states "the potential contact pathway for sodium chlorate and sulphur is through deposition of fugitive sulphur dust emanating from the sulphur forming and shipping facilities and depositing on the chlorate facility."*

a) *Clarify which data were used to determine the mixture proportions.*

b) *Clarify how the Maximum Yearly Cumulative Deposition of elemental sulphur was determined.*

A. The modelling results shown in Figure 2.5-14 were used to determine the mixing proportions of the sodium chlorate and sulphur in the 99.998% sodium chlorate and 0.002% sulphur test. The proportion of sodium chlorate in the sample was determined using data provided by Canexus.

B. The method used to determine the Maximum Yearly Cumulative Deposition of elemental sulphur is described in Volume IIA, Section 2.5.3 (with Appendix I), and is summarized below for easy reference.

The rotoform stacks and facility loading area will be sources of particulate emissions of sulphur. Figure 2.5-14 presents maximum predicted annual average sulphur deposition values (kg/ha/y) associated with Project emissions. They were estimated through use of the CALPUFF model (see Volume IIA, Section 2, Appendix I). The highest value of 1.1 kg/ha/y is predicted to occur along the south Site boundary.

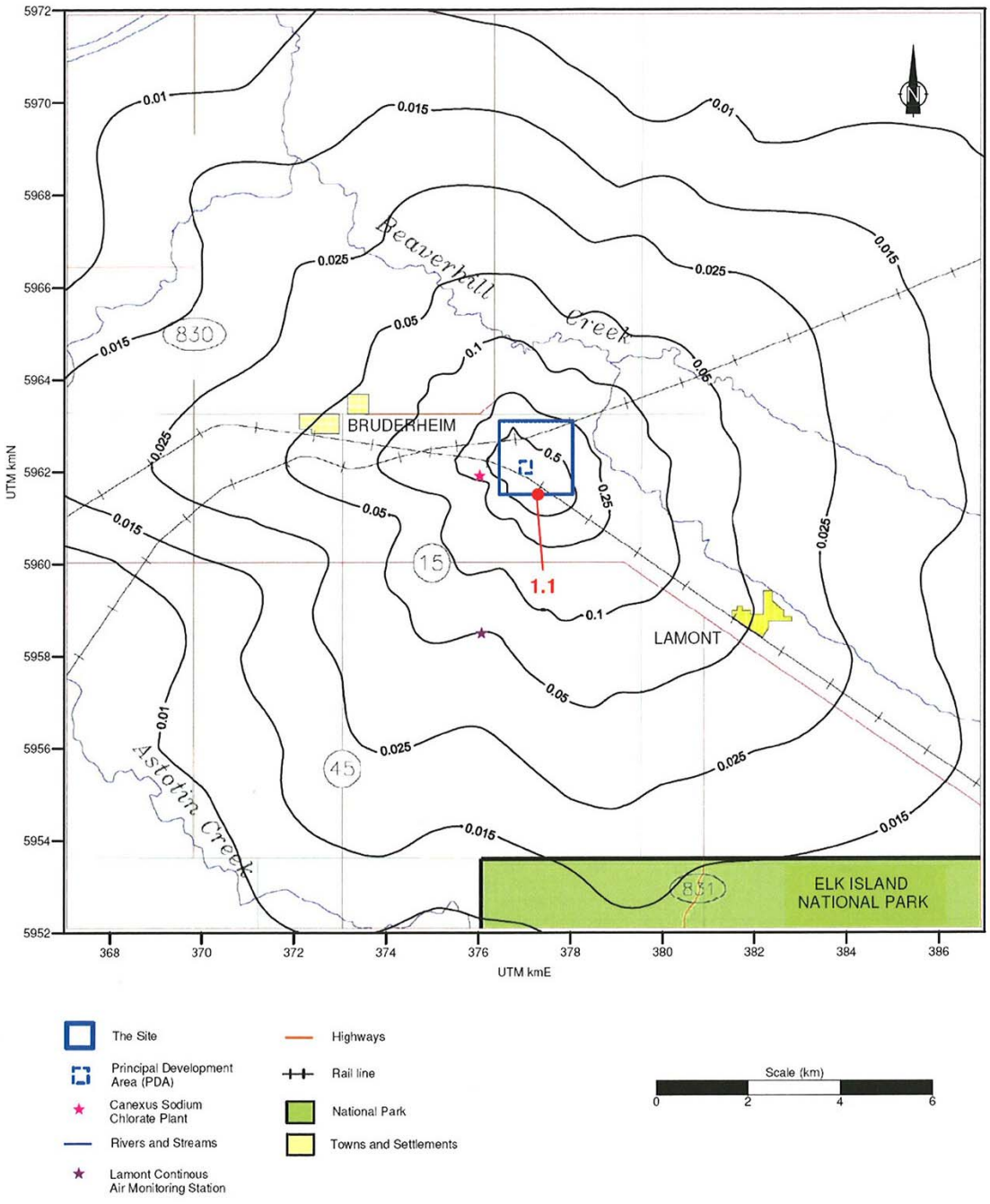


Figure 2.5-14: Isopleths of Maximum Predicted Annual Average Sulphur Deposition Values (kg/ha/y) associated with Project Emissions

112. ***Section 3, Page 3.*** *The SBAT test results illustrate the thermal instability of sodium chlorate when mixed with sulphur dust and oat flour; 90/10% mixtures of sodium chlorate with either sulphur or oat flour represent a potential hazard with a critical temperature for the sodium chlorate and sulphur mixture of 100°C; the critical temperature for the sodium chlorate and oat flour mixture is much higher at 188°C.*

a) *With reference to Figure A3, although the mixture of sodium chlorate and sulphur at a ratio of 99.998% and 0.002% by weight is not considered hazardous, it is unstable with an exothermic reaction at 103°C. What is the significance of the relatively small exothermic reaction (e.g., 6°C) and what is the significance of the endothermic reactions observed?*

A. The relatively small exothermic reaction that was observed is significant because the test predicts only small energy release under this mixing ratio, which is the worst-case mixing ratio predicted by the sulphur deposition model. Hence, a unique and significant risk to the sodium chlorate facility is not predicted by the test. We are not aware of any endothermic reactions occurring in tests run on the sodium chlorate/oat flour or sodium chlorate/sulphur mixtures.

113. ***Section 3.2, Page 3.*** *The Taliani test indicates that sodium chlorate and sulphur are incompatible at the ratio of 99.998% and 0.002 % by weight and unstable at 93°C.*

a) *Why was this test selected over the Differential Scanning Caliorimeter (DSC) Compatibility Test?*

b) *Why was the test not conducted with Sample 5 and Sample 6, the sodium chlorate mixtures with the higher proportion of sulphur and oat flour?*

c) *The measuring device that is used to detect the pressure changes is valid for approximately 70% of the compatibility tests, comment on the uncertainties associated with the use of this test with these substances.*

A. The Taliani test was completed to investigate reactivity in terms of potential pressure increase and visual indications and is considered to be comparable to the DSC test. Additional DSC testing would have been completed only if unusual results were obtained from the Taliani tests, which was not the case.

B. Based on the results of the tests completed on Samples 1 to 4, Taliani tests on Samples 5 and 6 were expected to be consistent with the SBAT tests completed on Samples 5 and 6. Hence, Taliani tests were not completed on these samples.

C. This statement is included to convey that the quantitative outcomes of the pressure measurements collected by the Taliani test are not as reliable as those for the other tests that were completed.

114. ***Section 4.0, Page 5.*** *AST states "the risks associated with the presence of fugitive sulphur dust in the vicinity of the Canexus chlorate plant are similar to those associated with the presence of crop dust, assuming that these materials are present in similar proportions." The risks may not be the same because the temperatures at which the risks occur for sodium chlorate and oat flour are much higher than those for sodium chlorate and sulphur.*

a) *What are the uncertainties associated with this comparison? Comment on the validity of the comparison.*

A. The comparison of the reactions between sodium chlorate and sulphur or oat flour were intended to provide a degree of qualitative context to background risks that exist for the manufacture of sodium chlorate. The reactions between sodium chlorate and oat flour and sulphur are similar but not identical. The reaction between sodium chlorate and sulphur is initiated at lower energy levels (approximately 200 ^{o}F) than the reaction between sodium chlorate and oat flour (approximately 370^{o}F). Both threshold temperatures are substantially higher than anticipated ambient temperatures. Once this reaction is initiated, the oat flour reaction occurred more vigorously in some of the tests. Neither mixture was observed to present an explosion risk. Hence, on balance, the mixtures were determined to present similar risks.

115. ***Section 4.0, Page 5.*** *The statement "mixtures of 70% sodium chlorate and 30% sulphur or oat flour are potentially explosive" does not seem to be substantiated by the data presented in the report and the source of this ratio was not provided.*

a) *Provide evidence to support this statement.*

A. The stated mixture of 70% sodium chlorate and 30% sulphur reflects the optimum mixing ratio of the two compounds as represented by the reaction formula: $3S + 2NaClO_3 = 3SO_2 + 2NaCl$. The testing firm also wanted to express their opinion that this ratio may be potentially explosive. It is recognized that this statement is not supported by the test data. The highest mixing ratio tested (90%:10%) approximates this optimum mixing ratio and was not found to be potentially explosive.

116. ***Section 4.0, Page 5.*** *AST states "Stronger exothermic responses are associated with the mixtures of 90% sodium chlorate with 10% oat flour or sulphur."*

a) *Explain the risk associated with the exothermic reaction of the 90/10% mixture at 99°C.*

A. Stronger exothermic reactions are observed for this ratio of mixing. These mixtures would be expected to burn with more rigour than the mixtures associated with 5 years deposition of elemental sulphur. No such mixture or combustion with organic dust has been observed, to our knowledge, by Canexus, and no such sulphur mixture is expected to occur as a result of the Project because the mixing ratios are orders of magnitude higher than those predicted by the sulphur deposition modelling. The likelihood of such an occurrence and the risks associated with such an occurrence are considered comparable to the situation which presently exists with organic matter during harvest.

117. ***No Specific Reference.*** *The critical temperature for sodium chlorate and sulphur mixtures is ~100°C; the flashpoint for sulphur is 207 °C and the auto-ignition is 232°C; the flammable limits in air are 35 g/m3 (LEL) and 1400 g/m3 (UEL).*

a) *Given the parameters cited above, what are the potential explosion hazards associated with the sulphur dust generated during formation and handling of the pastilles, as well as loading the material into hoppers for transportation?*

A. There are no explosive risks associated with the proposed Project because there is no opportunity for dispersion of sulphur dust in a confined space. This is one of the advantages of the sulphur storage and loading mechanism selected for the Project. The sulphur is formed, stored and transferred in an open space. There is no opportunity for concentration of sulphur dust within a confined space, and therefore, no risk of explosion of sulphur dust.

118. ***No Specific Reference.*** *Sulphur dust can have particles of different sizes ranging from 152 microns to 1674 microns; a dust explosion can only be initiated by dust particles less than 500 microns in diameter, but once initiated larger particles up to 1400 microns in diameter will contribute to the propagation of an explosion.*

a) *What were the sizes of the particles of sulphur comprising the mixtures with sodium chlorate?*

b) *If the pastilles are approximately 2 to 3 mm in diameter, what are the particle sizes of sulphur that will result from the forming, handling, and manipulation of the pastilles?*

A. The sulphur and sodium chlorate samples were mixed by hand to form a homogeneous mixture that is reported to have been sand-like in its composition. The grain size distributions were not determined as part of this program; however, by visual observation these samples are expected to have had a significant proportion of grain sizes less than the 500 micron threshold noted above.

B. The proposed forming process has been selected because it generates hard pastilles with an approximate diameter of 5 mm (Volume IIA, Section 2.1) that are not prone to deterioration during handling. Hence, the grain size distribution for the mass of sulphur pastilles produced is not expected to change significantly during the forming, handling and loading processes. Some dust is expected to be generated by this process. The modelling included in the assessment assumes that 0.2% of the total sulphur throughput will be susceptible to dust generation. This assumption is based on grain size analyses completed on behalf of Jacques Whitford, which indicated that 99.8% by weight of re-handled sulphur pastilles maintained a grain size greater than 2 mm (Attachment 4).

119. ***No Specific Reference.*** *Sulphur dust is capable of forming explosive mixtures when mixed with chlorates, nitrates, or other oxidizing agents; therefore, these materials must be kept separate and the minimum distance recommended is 30 m.*

a) *What is the minimum distance between sulphur storage and forming facilities and the storage of sodium chlorate on the adjacent property?*

A. The distance between the sulphur pastille storage area and the sodium chlorate storage facilities is in excess of 600 m.

120. ***Volume IIA, Section 2.5, Page 2-40.*** *To better evaluate the risk associated with the co-location of the two facilities an understanding of the potential products that form when sulphur and chlorate burn alone and when they ignite as a mixture is needed. There may be a greater risk associated with the products of combustion of the sodium chlorate and sulphur mixture than with the sulphur or the chlorate alone.*

a) *Were there combustion products identified in the testing, if so what were they and at what concentrations?*

b) *What are the emission levels of the different sodium chlorate products released?*

c) *What is the potential reactivity of the product emissions, including gaseous emissions, from the sodium chlorate plant with the product emissions, including sulphur dust and gaseous emissions from the Project?*

A. Combustion products were not determined as part of the reaction testing; however, the chemistry of the reaction is as follows: $3S + 2NaClO_3 = 3SO_2 + 2NaCl$. Hence, sulphur dioxide and salt (sodium chloride) are the predicted products. Sodium chlorate does not burn (oxidize) on its own because it is an oxidizer. Sulphur burns to form sulphur dioxide. Therefore, the environmental and health concerns associated with sulphur reacting with sodium chlorate are the same as sulphur reacting with oxygen in the atmosphere.

B. We are not aware of the precise emissions associated with the sodium chlorate facility. This information would be obtained by Canexus and is reported to AENV as part of their operating approval. Based on our knowledge of the facility it appears that fugitive and process emissions associated with the sodium chlorate facilities are relatively low. Our knowledge of the process suggests that sodium chloride (salt) and sodium hypochlorite may also be emitted from these processes, again at very low concentrations. Sulphur would potentially react with sodium hypochlorite in the same manner as it would react with sodium chlorate because sodium hypochlorite is also an oxidizer.

C. The potential reactivity of the product emissions is represented by the testing completed on the sulphur and sodium chlorate. Other than sulphur, there are no other potentially reactive process emissions associated with the proposed Project. The intermediate products of the sodium chlorate process are weaker oxidizers than sodium chlorate, such as sodium hypochlorite, which are expected to be less reactive than sodium chlorate. This conclusion is valid for both normal operating conditions and upset operating conditions.

1.9 SOCIO-ECONOMIC

121. ***Volume IIB, Section 4.6.2.6, Pages 4-37 to 4-38; Volume IID, Section 4.4.3.7, Pages 4-27 to 28.*** *AST states: "It should be noted that some landowners who have homes in the buffer zone near the proposed Project are concerned about a downturn in land values. Land in the buffer zone is subject to the Alberta Industrial Heartland's Voluntary Property Purchase Program and landowners in the area may receive fair value for their land, if appropriate if they choose to move based on the Project". AST also states "The property value impact during the operations phase is classified as a Class 3 impact. Since AST has no control over property values in the area, no mitigation measures are possible. It should also be noted that Alberta Industrial Heartland Association does have a Voluntary Property Purchase Program in place for homes within the buffer zone or areas zoned for industrial development with the Heartland."*

a) *Identify the number and locations of the homes within the buffer zone that are impacted by the proposed Project.*

b) *Verify that the Alberta Industrial Heartland Association Voluntary Property Purchase Program will be available to impacted homeowners.*

c) *Provide further analysis of the impact that the proposed Project may have on the property values in Bruderheim and Lamont.*

A. It is not possibly to predict the number and location of homes in the buffer zone that are impacted by the Project with respect to property values due to the following reasons:

- The boundaries of the buffer zone were modified by Lamont County following the filing of the EIA increasing the distance of the buffer zone from the Project. The buffer zone was formerly adjacent to the Project on the north and east borders of Section 35-55-20 (the Site). Under the revised boundaries, the closest occurrence of the buffer zone to the Site is the west half of Section 27-55-20 (approximately 2 km away). This distance is significant relative to the size of the Project. Project activities will not be noticeable from this distance (audible, visible, olfactory); hence, a measurable impact to property values in the newly created buffer zone is not anticipated as a result of the AST Project.
- The rezoning of lands previously zoned as buffer zone to heavy industrial zone in the vicinity of the Site will have positive impacts on properties located in the rezoned lands. The presence of the sulphur forming facilities will not affect the value of these lands.

It is difficult to predict what the cumulative effects of projects near the buffer zone will be on property values of residences in the buffer zone. Properties located in the reconfigured buffer zone are located within the Alberta Industrial Heartland and may be affected by the newly created zoning. Existing projects (Canexus, ERCO, Triton) located) closer to the buffer zone than the AST Project will not impact land values because they are existing and are accounted for in the present valuations. Because no additional projects have been announced for the industrial lands located in Lamont County, no adverse impacts to land values in the newly created buffer zone would be predicted for the current CEA case.

B. The Voluntary Property Purchase Program is available to residences located within the boundaries of the Alberta Industrial Heartland.

C. The future of property values in Bruderheim and Lamont are highly variable and not predictable for the following reasons:

- Property values can be assessed several different ways (i.e. option value versus hedonic pricing).
- Property prices in Alberta have increased dramatically in last few years, and there is still a high degree of uncertainty regarding the future of property values in the Province (Hamilton 2006, pers. comm.).
- Land use zoning boundaries may be modified.

Please refer to Volume IID Section 4.43.7 for more on the variability of property prices.

122. **Volume IID, Executive Summary, Page 4-i.** AST states: "*The Project's economic impact was calculated using the Alberta Economic Multipliers model developed by Alberta Finance (2006; see Table ES-1)*".

a) *Economic impact analysis are important for determining where the value added impacts come from (i.e., local or non-local expenditure) and to determine where these economic benefits flow to (i.e., a region, province or total country). Explain how the application of provincial multipliers is going to adequately address this.*

b) *Economic multipliers provide estimates of the gross increase in economic activity (gains) due to the project. Assess the potential declines (losses) in activity.*

i) The existing large-scale sulphur forming facilities in western Alberta and northeastern BC are not identified as competing businesses. What is the likelihood that these existing facilities will compete with AST and drive down processing revenues?

ii) If oversupply of processing capacity were to trigger downward price adjustments, is there a level that would see the facility go out of production?

iii) Consideration needs to be given to the impact that sulphur price risk will have on the economic impacts of operations. How will adverse changes in the commodity price impact the proposed Project? How significant and prolonged does a sulphur price decrease need to be for it to result in the closure of the facility? What is the likelihood of that outcome and what are the economic consequences?

A. Economic impacts were assessed using a provincial multiplier, as impacts can be understood in terms of the estimated effect to Alberta's Gross Domestic Product (GDP). By focusing on outputs (product) the analysis is "unduplicated" because GDP measures the value of final transactions only, with all inter-entity purchases and sales associated with intermediate steps of production cancelled out. There is a risk of double counting economic impacts if both the sale and purchase of an item are assessed. Therefore a GDP impact at a Provincial level is appropriate since it does not double count purchases and sales of a product (or component of a product) before the final transaction. The smallest scale input-output GDP based unduplicated multipliers are the Alberta based multipliers. Qualitative interviews reveal that AST will focus its spending locally in Lamont County as the Project is responsible for its own procurement and spending (as noted in Volume IID, Section 4.4.1.1). The local procurement is likely to mean that economic impacts will most likely occur locally in Lamont County. The multipliers in conjunction with qualitative data address the issue of where these economic benefits are expected to flow to a limited degree.

B. i) It is unlikely that these existing facilities will compete with AST and drive down processing revenues for two reasons. First, these facilities are generally not on the direct transportation path to the west coast shipping terminals. Second, these facilities are currently running near capacity. There is a large amount of sulphur being produced in Western Canada, with an inventory of between 12-13 million tonnes of sulphur in blocked form, and an estimated annual production of 7.7 million tonnes per year (Volume IID, Section 4.1.1), which is increasing.

Based on the anticipated demand for sulphur forming in western Canada it is unlikely that existing facilities will compete with AST's facility.

ii) The Contingency Plan to respond to fluctuating market conditions is provided in Volume I, Section 2.2.4. In the event that sulphur markets deteriorate to the extent that sulphur marketing is no longer viable, the Bruderheim facility will reduce its operations or become idle. AST has the financial and operational capability to operate, expand or idle the facility as market conditions demand. There is no specific price point for sulphur processing that would trigger temporary shutdown of the facility.

iii) The Facility Market Analysis is provided in Volume 1, Section 2.2.1. Export demand is expected to increase over the next few years. Demand for Alberta sulphur, for both domestic use and export, is expected to rise slowly, reaching 7.5×10^6 t/y by the end of the forecast period. Forecasts are currently available through 2013. A ten year forecast is considered to be less reliable but is expected to follow similar trends as Alberta production continues to move to heavy oil and world demand for sulphur gradually rises. The decision to form sulphur (and therefore operate the Bruderheim facility) or to store this sulphur in block form resides with the sulphur generators, not with AST.

123. **Volume IID, Section 4.3, Page 4-7.** AST states: "*Throughout this baseline assessment data from the 2001 Canadian Census (conducted by Statistics Canada) will be used. The 2001 data represents the most recent and complete data set available through Statistics Canada.*"

a) *To evaluate the economic impacts of a change in land use it is useful to detail past growth trends. In the absence of historical trend analysis, identify the assumptions AST used to determine the anticipated changes in population, employment, housing and business activity.*

A. Past trends were assessed in Section 4.3 of Volume IID, and included the assessment of data generated by the 1996 census. Certain assumptions were also used, which included the following assumptions made by interviewees, and confirmed by statistics gathered for the Project.

- High levels of population growth beyond the baseline level are not expected without outside intervention (i.e., new projects / employment).
- Employment rates would remain high, unemployment rates would remain low, and the labour force would remain high as a percentage of the population.

No housing activity had been officially announced as of the baseline assessment, and new housing starts were not incorporated into the assessment.

124. **Volume IID, Section 4.3.3, Pages 4-10 to 4-12.** Senior citizens comprise about one-quarter of the Town of Lamont's population. 2006 census data show that Lamont is home to 110 individuals over the age of 84.

a) *Identify any health concerns or other concerns specific to the elderly.*

A. Based on interviews with stakeholders and key service providers the only concerns that impact the elderly, above and beyond impacts stated in the report, are health concerns related to

emissions. However, the majority of individuals over the age of 84 live in the old age residences in the Town of Lamont or Bruderheim, which are expected to experience no emissions related impacts due to the Project (see Volume IIA) because of the distance between these residences and the Project. In addition, the results of the HHRA in the EIA did not predict acute or chronic health impacts.

125. **Volume IID, Section 4.3.5, Page 4-16.** AST states: "*Bruderheim has higher levels of unemployment compared to other areas in the LSA.*"

a) *Provide unemployment rates by age group and gender.*

b) *Comment on opportunities for AST to target the unemployed or under-employed.*

A. No data are available for the area regarding unemployment by age or gender.

B. AST plans to hire locally whenever possible and practical. As described in Sections 4.3.5 and 4.4.3.3, while Bruderheim has higher levels of unemployment than other areas in the LSA and RSA, employment levels are still relatively high. By aiming to hire locally AST endeavours to target local unemployment. Section 4.4.1 describes AST's recognition of, and intent to, support local suppliers for goods and services required for the Project. AST will buy locally whenever practical, throughout the construction and operation of the Project, in order to support employment in other industries in the LSA/RSA. These are indirect mechanisms for targeting the under-employed or unemployed in the area.

126. **Volume IID, Section 4.4.2.2, Pages 4-18 to 4-20.** AST states: "*A brief synopsis of this methodology is provided in Appendix II and the methodological limitations are presented in Appendix III.*"

a) *The limitations listed in the Appendix refer to the use of these estimates for provincial impact assessment. The larger the area, the more economic activity will likely occur within the area and thus the higher the multiplier. Lower multipliers for smaller areas reflect the fact that much of the subsequent expenditure 'leaks out' to other areas. Has there been any consideration given to the interdependence of sectors in the local economy and what portion of supplies and services would likely be purchased outside the local area? List the limitations and how it affects the assessment.*

A. As mentioned in Volume IID, Section 4, Appendix III, "The relationships of input-output models are simple proportionalities which imply that marginal changes are equal to average changes. This feature makes input-output models convenient to use. Proportional relationships may not always be present, even if they are represented as such by the Multipliers. Therefore economies or diseconomies of scale cannot be represented." With the above in mind it is not possible using the Alberta Economic Multipliers to define the distribution of impacts inside and outside of the Local Study Area. However, AST intends to support local suppliers for goods and services required for the Project. AST will buy locally whenever practical throughout the construction and operation of the Project.

127. **Volume IID, Section 4.4.3.2, Pages 4-22 to 4-24.** AST states: "*For the operations phase, industry-based tables from Alberta Economic Multipliers for Support Activities for Mining and Oil and Gas Extraction (see Table 4.4-4) were used.*"

a) *Explain the rationale for using the category of "mining and oil gas extraction" for AST's analysis of economic impact.*

A. The category used for analysis of economic impacts was "Support Activities for Mining and Oil and Gas Extraction" (Volume IID, Section 4.4.3.2). This is an appropriate category as dealing with by-products of the oil and gas sector is viewed as a support service to the oil and gas sector.

128. **Volume IID, Section 4.4.3.2, Pages 4-22 to 4-24.** AST states: "*at the 3,000 t/d level, labour income would increase by 0.724 x $19.7 million/y = $14.3 million/y*."

a) *For labour income, the direct, indirect, and induced effects represent the amount of labour income required in millions of dollars for one million dollars of output. Clarify if AST is suggesting that this scale of operation (22 FTEs) is capable of generating $14.3 million in household income. Explain AST's rationale for using the higher multiplier.*

b) *The Project is estimated to employ directly or indirectly 45 people with an estimated labour impact of $14.3 million annually (at the 3.000t/d level). This implies a labour impact of $318,000 per individual ($14.3 million divided by 45 people). Clarify how the labour income impact inter-relates with the total employment impact.*

A. The economic effects of the labour related to the operations phase of the Project were calculated using the Alberta Economic Multipliers model (Alberta Finance 2006). All impacts are presented in per year economic impacts. For the operations phase, industry-based tables from Alberta Economic Multipliers for "Support Activities for Mining and Oil and Gas Extraction" were used. Using this multiplier, it was calculated that $19.7 million in sales could generate $14.3 million in direct, indirect and induced labour related economic impacts per year. This impact is not a direct impact to household income, but rather represents direct, indirect and induced labour related economic impacts.

B. Direct employment only represents a portion of the labour related economic impacts. Labour impacts also include indirect employment and associated impacts, along with induced economic impacts. Labour income is only a portion of the total employment impact.

129. **Volume IID, Section 4.4.3.2, Pages 4-22 to 4-24.** AST states: "*AST's total taxes from land, buildings, machinery, structures, machinery and equipment are projected to be $460,077/y with an estimated $62,387 paid to the Alberta School Foundation; $388,128 in municipal taxes; and $9,562 paid to the County of Lamont Foundation. Other than the Alberta School Foundation, all taxes (roughly 86%) will be paid to authorities in the LSA and RSA.*"

a) *Estimate the percentage increase that the Project's total taxable assessment could have on the County's overall assessment base, use the current assessment base.*

A. Based on personal communications with The Count of Lamont, tax revenues from commercial activities in 2007 were $1,098,435.29. AST is expected to pay $460,077 per year in taxes, of

which an estimated $400,000 are expected to go to the County of Lamont. Therefore, AST's project may add an estimated 37% to Lamont County's tax revenues received from commercial activities.

130. **Volume IID, Section 4.5.4.1, Page 4-30.** AST states: "*Therefore the economic impact of transporting finished pastilles will be between $27.4 million/y and $54.8 million/y. It should be noted this economic impact will be spread over Alberta and British Columbia as trains will transport the formed sulphur across both provinces. Therefore, a portion of this economic impact is already captured by using the Economic Multipliers in Section 4.4.3.*"

a) *Explain AST's rationale behind the statement that "a portion of this economic benefit associated with transportation has been captured in Section 4.4.3" when it appears that the annual sales are exclusive of transportation costs.*

A. The input-output multiplier used in Volume IID, Section 4.4.3 includes all the transactions and contributions to Alberta's GDP in bringing a product to market. Since transportation is part of the process of bringing a product to market and the transport occurs in both Alberta and British Columbia, a portion of the transportation impacts have been captured using the multiplier.

1.10 NOISE

131. **General.** Section 2.1.2.2 of Directive 038 states that "*Licensees may choose to conduct a background noise survey to determine the total noise levels that currently exist in an area for information purpose." Therefore, the background noise level obtained during the 24-hr survey can not be used as the ambient level in cumulative noise model predictions. The EUB requires ambient conditions be either 35dBA (for typical rural settings) or the PSL - 5 dBA. In the case of AST's NIA, the ambient would be set at 40 dBA for residents 1, 2, 3 and 5, and 35 dBA for resident 4.*

a) *Resubmit all modeling results showing cumulative sound levels with the new ambient value.*

A. The tables below provide the updated cumulative sound levels based on the new ambient value suggested in SIR 131:

Table ES-1: Daytime Sound Levels

Residence	Assumed Baseline Daytime Sound Level (dBA L_{eq})	Predicted Daytime Sound Level Contribution (dBA L_{eq})		Combined Daytime Sound Levels (dBA L_{eq})		Daytime EUB PSLs (dBA L_{eq})
		Facility Sources Only	Facility and Transportation Sources Together	Facility Sources Only	Facility and Transportation Sources Together	
Residence 1	50	39.0	44.6	50.3	51.1	55
Residence 2	50	32.3	37.0	50.1	50.2	55
Residence 3	50	34.4	38.9	50.1	50.3	55
Residence 4	45	31.4	38.2	45.2	45.8	50
Residence 5	50	31.8	39.6	50.1	50.4	55

Table ES-2: Nighttime Sound Levels

Residence	Assumed Baseline Nighttime Sound Level (dBA L_{eq})	Predicted Nighttime Sound Level Contribution (dBA L_{eq})		Combined Nighttime Sound Levels (dBA L_{eq})		Nighttime EUB PSLs (dBA L_{eq})
		Facility Sources Only	Facility and Transportation Sources Together	Facility Sources Only	Facility and Transportation Sources Together	
Residence 1	40	39.0	41.1	42.5	43.6	45
Residence 2	40	32.3	34.9	40.7	41.2	45
Residence 3	40	34.4	37.4	41.1	41.9	45
Residence 4	35	31.4	36.6	36.6	38.9	40
Residence 5	40	31.8	37.9	40.6	42.1	45

Table 3.7-5: Predicted Combined Sound Level Contribution of the Project Alone and Existing Sound Levels

Residence	Assumed Existing Sound Level		Predicted Sound Level Contribution of Project Alone		Predicted Combined Sound Level Contribution	
	Daytime (dBA L_{eq})	Nighttime (dBA L_{eq})	Daytime (dBA L_{eq})	Nighttime (dBA L_{eq})	Daytime (dBA L_{eq})	Nighttime (dBA L_{eq})
Residence 1	50	40	39.0	39.0	50.3	42.5
Residence 2	50	40	32.3	32.3	50.1	40.7
Residence 3	50	40	34.4	34.4	50.1	41.1
Residence 4	45	35	31.4	31.4	45.2	36.6
Residence 5	50	40	31.8	31.8	50.1	40.6

Table 3.7-6: Predicted Combined Sound Level Contribution of the Project Associated Transportation Sources and Existing Sound Levels

Residence	Assumed Existing Sound Level		Predicted Sound Level Contribution of Project and Associated Transportation Sources		Predicted Combined Sound Level Contribution	
	Daytime (dBA L_{eq})	Nighttime (dBA L_{eq})	Daytime (dBA L_{eq})	Nighttime (dBA L_{eq})	Daytime (dBA L_{eq})	Nighttime (dBA L_{eq})
Residence 1	50	40	44.6	41.1	51.1	43.6
Residence 2	50	40	37.0	34.9	50.2	41.2
Residence 3	50	40	38.9	37.4	50.3	41.9
Residence 4	45	35	38.2	36.6	45.8	38.9
Residence 5	50	40	39.6	37.9	50.4	42.1

Table 3.8-5: Comparison of Combined Sound Levels (Project Alone and Existing Sound Levels) to PSLs

Residence	Daytime PSL (dBA L_{eq})	Daytime Predicted Combined Sound Level (dBA L_{eq})	Daytime Margin of Safety (dBA L_{eq})	Nighttime PSL (dBA L_{eq})	Nighttime Predicted Combined Sound Level (dBA L_{eq})	Nighttime Margin of Safety (dBA L_{eq})
Residence 1	55	50.3	**4.7**	45	42.5	**2.5**
Residence 2	55	50.1	**4.9**	45	40.7	**4.3**
Residence 3	55	50.1	**4.9**	45	41.1	**3.9**
Residence 4	50	45.2	**4.8**	40	36.6	**3.4**
Residence 5	55	50.1	**4.9**	45	40.6	**4.4**

Table 3.8-6: Comparison of Combined Sound Levels (Project, Associated Transportation Sources and Existing Sound Levels) to PSLs

Residence	Daytime PSL (dBA L_{eq})	Daytime Predicted Combined Sound Level (dBA L_{eq})	Daytime Margin of Safety (dBA L_{eq})	Nighttime PSL (dBA L_{eq})	Nighttime Predicted Combined Sound Level (dBA L_{eq})	Nighttime Margin of Safety (dBA L_{eq})
Residence 1	55	51.1	**3.9**	45	43.6	**1.4**
Residence 2	55	50.2	**4.8**	45	41.2	**3.8**
Residence 3	55	50.3	**4.7**	45	41.9	**3.1**
Residence 4	50	45.8	**4.2**	40	38.9	**1.1**
Residence 5	55	50.4	**4.6**	45	42.1	**2.9**

Table 3.9-1: Incremental Impact of Proposed Project Alone

Residence	Assumed Daytime Sound Level (dBA L_{eq})	Daytime Combined Sound Level (dBA L_{eq})	Daytime Incremental Impact (dBA L_{eq})	Assumed Nighttime Sound Level (dBA L_{eq})	Nighttime Combined Sound Level (dBA L_{eq})	Nighttime Incremental Impact (dBA L_{eq})
Residence 1	50	50.3	**0.3**	40	42.5	**2.5**
Residence 2	50	50.1	**0.1**	40	40.7	**0.7**
Residence 3	50	50.1	**0.1**	40	41.1	**1.1**
Residence 4	45	45.2	**0.2**	35	36.6	**1.6**
Residence 5	50	50.1	**0.1**	40	40.6	**0.6**

Table 3.9-2: Incremental Impact of Proposed Project plus Transportation Sources

Residence	Assumed Daytime Sound Level (dBA L_{eq})	Daytime Combined Sound Level (dBA L_{eq})	Daytime Incremental Impact (dBA L_{eq})	Assumed Nighttime Sound Level (dBA L_{eq})	Nighttime Combined Sound Level (dBA L_{eq})	Nighttime Incremental Impact (dBA L_{eq})
Residence 1	50	51.1	**1.1**	40	43.6	**3.6**
Residence 2	50	50.2	**0.2**	40	41.2	**1.2**
Residence 3	50	50.3	**0.3**	40	41.9	**1.9**
Residence 4	45	45.8	**0.8**	35	38.9	**3.9**
Residence 5	50	50.4	**0.4**	40	42.1	**2.1**

The revised cumulative daytime sound levels increased for residences 2, 3 and 5 as a result of increases in assumed ambient sound levels (Table ES-1). For all other cases (daytime for residences 1 and 4, nighttime for all 5 residences), the revised cumulative sound level decreased (Tables ES-1 and ES-2).

In all cases, there is a positive margin of safety, indicating the predicted combined sound levels are always below the permissive sound levels determined for the nearest residences (Tables 3.8-5 and 3.8-6).

132. **Volume IIA, Executive Summary, Pages 1-iv to 1-v.** AST states that "*Mitigating measures to reduce noise impacts would include restricting transportation to daytime periods only*."

a) *Clarify if transportation includes railway traffic.*

b) *Confirm that AST will commit to this mitigation.*

A. Transportation includes both truck traffic and railway traffic. In Volume IIA, Section 3.7.1, AST indicated all truck traffic will be restricted to daytime hours. Therefore, railway traffic is the only transportation source during the night time hours.

B. No mitigation measures are required pertaining to night time rail traffic as the cumulative predicted sound levels comply with the sound levels indicated in the methodology requested in SIR 131.

133. **Volume IIA, Section 3.7.1.2, Page 3-8.** AST states "*The ISO Standard assumes moderately downwind conditions…*"

a) *Provide the wind speed that was used in the model.*

b) *Clarify whether each resident was modeled with downwind conditions.*

A. The wind speed that was used in the model (ISO standard) was between 1 m/s (3.6 km/h) to 5 m/s (18 km/h), measured at a height of 3 m to 11 m above the ground.

B. Each residence was modelled with downwind conditions.

134. **Volume IIA, Section 3.7.1.2, Page 3-10**. AST states "*The daytime and nighttime predictions are the same because all facility equipment is assumed to run continuously*".

a) *If the model accounts for different atmospheric conditions in the day and at night, explain why the numbers are the same.*

A. The computer model uses the same atmospheric conditions for both daytime and night time periods. Therefore, the predictions for continuously operating equipment will be the same during both the daytime and night time periods.

135. **Volume IIA, Section 3.8.1, Page 3-16.** AST states "…*the current measured sound levels already exceed the nighttime PSLs at Residence 1 and Residence 4. Therefore, comparing any cumulative sound levels that include the current measured sound level to the PSL is not appropriate for these two residences.*"

a) *Provide a cumulative assessment at these residents to include sound levels from the Project.*

A. The revised comparison of the cumulative predicted sound levels to the permissible sound levels is shown in Tables 3.8-5 and 3.8-6. This comparison shows that the predicted cumulative sound levels (described as "combined" sound levels) are always below the permissible sound levels. It can, therefore, be concluded that the AST facility will be in compliance with EUB (now ERCB) Directive 038.

136. ***Volume IIA, Section 3.8.5, Tables 3.8-6 and 3.9-2, Pages 3-17 to 3-19.*** *The nighttime PSLs are exceeded for three residences for the combined scenario (i.e. Residence 1, 4, and 5). AST states: "These exceedances are due to the measured sound levels already exceeding the EUB PSL, not due to the contribution from the Project and associated transportation sources." Table 3.9-2 shows that the Project plus Transportation Sources make incremental impacts on the PSLs. If the Project is contributing to the overall sound level, then the Project is responsible for noise impacts.*

a) *Identify what mitigation measures are available to minimize effects associated with noise.*

b) *Outline AST's response plan should noise complaints arise.*

A. To minimize effects associated with noise the following mitigation measures were recommended in the EIA:

"Construction activities shall be confined to daytime hours. Furthermore, AST will consider appropriate mitigation measures to minimize the effect of construction noise at nearby residential locations in close proximity to the Site and keep these residents informed of abnormal noise causing activities, including noise during commissioning and start up."

Mitigation measures to reduce the noise impact also include restricting transportation activities to daytime periods only.

B. AST will investigate any noise complaints that arise and implement mitigation measures where reasonable and effective to address potential noise issues affecting nearby residences.

1.11 PUBLIC CONSULTATION

137. ***Volume IID, Executive Summary, Table ES-1, Pages 5-iii to 5-v; Table 5.7-1, Pages 5-24- 5-27.***

a) *It is not readily apparent from reading the tables which issues have been resolved and which remain unresolved. Identify which issues, in AST's opinion, have been resolved and which remain unresolved. Given the contentious nature of the Project explain how AST determined, or will determine, whether an issue has been sufficiently resolved.*

b) *Clarify whether the concerns voiced by the Fire Chiefs of Bruderheim and Lamont with respect to specific sulphur training has been addressed through mitigation measures.*

c) *Issue 2 - Clarify whether the air quality testing performed identified any potential issues for people with respiratory ailments that reside in the LSA.*

d) *Issue 25 – Has AST begun the tendering process for the construction of the proposed facility and, if so, how does the tender document deal with the local labour and procurement issues?*

e) *Issue 27 – The tax revenue figures presented in this table do not agree with the table and narrative found in Section 4.4.3.2. Update these sections accordingly.*

A. The attached table (Table 137-1) provides a compilation of the remaining issues, as summarized from formally submitted Statements of Concern in comparison with those that were submitted in response to the original Application.

Fifteen individuals, one municipality and two businesses submitted Statements of Concern to AENV during the public review period of the EIA. To determine which issues have been resolved and which remain unresolved, the Statements of Concern received from the public during the EIA Public Review period were evaluated and cross-referenced to the Stated Issues identified by the Public Consultation section of the EIA and presented in the Table ES-1 and Table 5.7-1 in Volume IID, Section 5.

The Stated Issues identified by the highest number of authors were concerns regarding sulphur fires and the emergency response plan; negative impacts on water in terms of quality and/or quantity; inadequate emergency response planning respecting the Project's proximity to Bruderheim and Lamont; and compliance with regulatory standards including the highest Safety and Environmental Stewardship standards.

Table 137-1: Number of Statements of Concern that addressed Stated Issues during EIA public review period

Stated Issues	AST Measures to Address Issues: EIA Section Cross reference	Number of SOCs
1. Negative impacts on water in terms of quality and/or quantity	Detailed evaluations of potential impacts to surface and ground water are provided in Volume IIB, Section 2: Groundwater Quantity and Quality; Section 3: Surface Water Quantity; and Section 4: Surface Water Quality. Potential for impacts to surface water quality will be effectively mitigated by collecting, containing and using runoff from the sulphur processing area that could be impacted by elemental sulphur. The runoff water collected and used in this manner represents only a minor proportion of runoff in the catchment area; hence, the potential impact to surface water quantity is insignificant. Potential impacts to groundwater quality will be effectively mitigated by double-lining all sulphur and chemical storage and water containment facilities. These facilities will also be equipped with leak detection capability. Groundwater will be used to provide make-up water for cooling. The yield of the aquifer beneath the Site is marginal relative to the Project's needs. Detailed monitoring of groundwater withdrawal will be implemented to identify potential impacts to adjacent groundwater users. If unacceptable impacts are observed, groundwater diversion will be stopped and an alternative water supply (Lamont County Water Utility) will be used.	12
2. Air contamination and sulphur dust	Potential air quality impacts are evaluated in Volume IIA, Section 2: Climate and Air Quality. Analysis included assessment of H_2S, SO_2, NO_x, particulate, etc. under normal and emergency operating conditions. These evaluations concluded that all parameter concentrations remain below 10% of the AAAQO at the fence line of the Site. Potential impacts to soil pH associated with elemental sulphur dust are predicted to be confined to the area immediately surrounding the process facilities and to the Site proper. Potential impacts related to fugitive sulphur dust are effectively mitigated by implementing good management practices, using sulphur dust suppressants and selecting forming technology that minimizes the generation of dust. Potential for air emissions is mitigated by treating air vented from liquid sulphur storage tanks and transfer points and implementing best safety and site management practices, including reliable emergency response capability.	9

Stated Issues	AST Measures to Address Issues: EIA Section Cross reference	Number of SOCs
3. Increased road traffic	A traffic study completed to support the Project (Volume I: Project Description, Appendix III) concludes that impacts to traffic volume are relatively minor in comparison to current and predicted traffic volumes. An upgrade to the intersection of Highway 15 and R.R. 202 was recommended and will be implemented as part of Project construction.	8
4. Impact on land values	Potential impacts to land values were evaluated as part of Volume IID, Section 4: Socio-Economic Assessment. This evaluation found that the Project is not expected to decrease land values in the area already zoned for heavy industrial use. It was not possible to project land values in the buffer zone or Towns of Bruderheim and Lamont. Some interviewees voiced concerns about the potential for a decrease in land values, especially for areas in the buffer zone. Land in the buffer zone is subject to the Alberta Industrial Heartland's Voluntary Property Purchase Program and landowners in the area will receive fair value for their land if they choose to move based on the Project.	8
5. Sulphur fires/ Emergency Response Plan (ERP)	Potential for sulphur fires and related emergency response planning is addressed in Volume I, Appendix V: Emergency Response Plan. While the risk of sulphur fires exists, sulphur burns very slowly and can be easily extinguished. The consequences of typical sulphur fires are not significant. The potential impacts of sulphur fires are best managed by developing and maintaining vigilant fire monitoring and response capability. AST will belong to NR CAER, the emergency response cooperative of industries operating in the Industrial Heartland.	14
6. Impact on human health	Public Health and Safety (Volume IIA, Section 4) concludes no unacceptable risks to human health occur during either normal operating conditions or sulphur fires. The primary human health risk occurs during sulphur fires (see above) and is associated with SO_2 emissions. These risks will be mitigated by diligently monitoring for fires, H_2S and SO_2; implementing an effective Health and Safety Plan (see Appendix IV of Volume I); and by the implication and maintenance of effective fire detection and response capabilities (see Item 5).	9
7. Soil contamination	The primary risk of soil contamination is associated with deposition of fugitive sulphur dust. Volume IIC, Section 2: Soil concludes that significant impacts to soil quality will be limited to the Site and area immediately surrounding the facility. Mitigation will include minimizing fugitive sulphur dust emissions (see Item 2 above), monitoring and, if necessary,	6

Stated Issues	AST Measures to Address Issues: EIA Section Cross reference	Number of SOCs
	neutralizing potential soil acidity.	
8. Impact on health of livestock	No impacts to domestic livestock are anticipated. According to Volume 2A, Section 2: Climate and Air Quality, all air emission concentrations of chemicals of potential concern are well below the threshold of concern for human health. Therefore, the concentrations are not expected to harm domestic stock. Sulphur compounds do not bioaccumulate and are not a concern from the perspective of ingestion by livestock. As well, no significant impacts to water quality are anticipated and, therefore, no ingestion concerns are anticipated. Results of The Caroline Livestock Study (Waldner 2004, Internet Site) indicate that the average herd health of 1300 cattle monitored between 1991 and 2003 in the Caroline sour gas plant area did not change after sour gas plant operations began in 1991. A second study, conducted by the Western Inter-Provincial Scientific Studies Association (WISSA) found few associations between oil and gas facility emissions and the overall health of cattle (WISSA 2006, Internet Site). The WISSA study collected and analysed data from 33,000 cattle in Alberta, Saskatchewan and northeast British Columbia. Based on the findings of these studies and the results of the air quality modelling presented in Volume IIA, Section 2: Climate and Air Quality, no impacts on livestock are expected due to the Project.	-
9. Increased rail traffic and decreased safety	According to Volume I, Appendix III: Traffic Impact Assessment, the increase in rail traffic outside of the Site and the potential for safety issues related to rail traffic is not significant. During peak operations, one daily liquid sulphur train and one formed sulphur train every two days are anticipated.	10
10. Sulphur blocking will be happen in the future	In response to this public concern, AST's initial intention to block sulphur was removed from the Project design. Sulphur blocking is not included in this Application and it is not AST's intention to implement sulphur blocking at this Site now or in the future. Any plans to block sulphur would require a separate application, public consultation and approval under EPEA (see Volume I, Section 3.1.1). Should sulphur markets deteriorate to the extent that sulphur marketing is no longer viable, the Bruderheim facility could reduce its operations or become idle. AST has the financial and operational capability to operate, expand or idle the facility as market conditions demand (see Volume I, Section 2.4.4).	2

Stated Issues	AST Measures to Address Issues: EIA Section Cross reference	Number of SOCs
11. Sulphur smells	Potential for odours associated with the Project were evaluated in Volume IIA, Section 2: Climate and Air Quality. It concluded no unusual or obnoxious sulphur odours are expected outside of the boundaries of the Site.	6
12. Inadequate Emergency Response Plan (ERP)/ Project proximity to Bruderheim and Lamont	The ERP (Volume I, Appendix V) was reviewed and approved by a local emergency response expert and complies with the requirements of EUB Directive 071: Emergency Preparedness and Response Requirements for the Upstream Petroleum Industry. Further, AST will become an active member of NR CAER, an emergency response cooperative of industrial operators in the Industrial Heartland.	12
13. Lack of trust in AST	AST continues to implement its public consultation program as detailed in Volume I and Volume IID, Section 5: Public Consultation. A public consultation committee has been established to improve communication, establish trust with the local community and facilitate public input into the Project's design and operation.	6
14. Impact on wildlife	Volume IIC, Section 4: Wildlife and Section 5: Biodiversity addresses potential impacts to wildlife, which are expected to be minor. The area's primary natural feature, the wetland in the northwest corner of the Site, will be conserved as part of the Project.	-
15. Negative visual impact	According to Volume IIA, Section 3: Noise and Light, the proposed facilities are relatively low lying (maximum height 15 m) and set back a considerable distance from access roads and rural residences (500 m from the nearest residence). They occupy a maximum of 3% of the field of vision above the horizon (assuming flat ground and unimpeded view). Visibility is also reduced by shrubs and trees surrounding the Site. Further development of trees and natural visual buffers is possible if specific views are compromised.	4
16. Light pollution	The facility will operate 24 hours/day and will be lit to allow nighttime operation, resulting in a light impact similar in nature to the Canexus chlorate plant located to the southwest of the Project. Light associated with the Project will diminish with distance through adsorption and dissipation and will be directed into the process area (rather than the surrounding ground). Vegetation and buildings will also act as barriers to light travel.	-

Stated Issues	AST Measures to Address Issues: EIA Section Cross reference	Number of SOCs
17. Lamont County will become a hazardous waste area	No hazardous wastes will be generated by the Project.	-
18. Increased noise	The predicted sound levels of the Project alone are well below EUB permissible sound levels (PSLs) and will remain below the PSLs even when transportation sources are added. AST will investigate any noise concerns expressed by surrounding residents.	5
19. Overall loss of farmland to industry in the area	Volume IID, Section 2: Land Use and Reclamation assesses land use in the area and the Project's impacts on land use. The Project will result in a small reduction in agricultural land in the area, but the reduction is limited to lands zoned for industrial use and farmland that, on balance, is rated as poor quality.	-
20. Impedes future economic development	The socio-economic and social impacts associated with the Project are assessed in Volume IID, Section 4: Socio-Economic Assessment. There is no evidence the Project's development has the potential to impede future economic development.	-
21. Negative impact on vegetation	Potential impacts to vegetation are addressed in Volume IIC, Section 3: Vegetation. Vegetation in the potentially impacted area surrounding the PDA will be protected as a result of the proposed soil monitoring and mitigation program described in Vegetation and in Items 2 and 7. The results of the monitoring programs will be evaluated to determine if modifications to mitigation plans are required to reduce impacts. Additional mitigation steps will be taken to reduce the potential for establishment of noxious weeds that may occur as part of the industrial development.	-
22. Ensure AST complies with regulatory standards, including highest Safety and Environmental Stewardship standards	AST/HAZCO intends to comply with all regulatory standards and has demonstrated its commitment through the compliant operation of more than 20 industrial facilities in Alberta.	12
23. Possible hazardous effects of mixing sulphur with chlorate	Testing is underway to compare the potential reactivity of sulphur and chlorate to that of other common organic particulates. Results will be reported to the NRCB and AENV independently, and communicated to interested stakeholders.	7

Stated Issues	AST Measures to Address Issues: EIA Section Cross reference	Number of SOCs
24. Concern over AST's public relations in the area	AST continues to implement its public consultation program as detailed in Volume I and Volume IID, Section 5: Public Consultation. A public consultation committee has been established to improve communication, establish trust with the local community and facilitate public input into the Project's design and operation.	2
25. Adequate use of local labour	The Project will employ an estimated 22 people during the operations phase. AST has stated that local labour is preferred and will be given primary consideration for employment, providing work quality and safety are not compromised.	-
26. Construction quality	AST will follow standard engineering practices.	-
27. Tax revenue and benefits for the County	Projected taxes on AST assets are approximately $460,000 with an estimated $388,128 in municipal taxes, $62,387 to the Alberta School Foundation and $9,562 to the County of Lamont Foundation.	5
28. Plant location not appropriate due to its proximity to two towns and rural populations; should be a remote area	Although Lamont County is largely an agricultural area and the proposed AST facility is near the Towns of Lamont and Bruderheim, the facility will be located in a zone approved by the County for heavy industrial use. The facility's proximity to the Towns of Lamont and Bruderheim and the rural population is addressed in AST's ERP (Volume I, Appendix V) and Item 5 above.	9
Note: "-" indicates no SOC identified this stated issue as a separate item.		

To evaluate whether or not the Stated Issue was resolved, the Screening Report issued by AENV on April 7, 2006 was reviewed. According to the Screening Report the following Statements of Concern were submitted to AENV during the Project's Public Disclosure:

- "A petition from the Friends of Lamont County containing 1051 form letters expressing concerns regarding potential environmental impacts, traffic and social issues;
- 261 form letters from individuals and families outlining eight areas of concern: property value, noise pollution, air emissions, soil contamination, transportation issues, sulphur fires and emergency response plan, "tip of the iceberg" and trust issues. Each issue had check boxes for specific items related to the issue. Many also provided personal comments on the form letters;
- 43 written letters from individuals and families expressing concerns with the Project; and
- 25 form letters and 1 written letter in support of the Project." (AENV 2006).

Based on the number of Statements of Concern submitted during the EIA Public Review Period compared to the Public Disclosure period, it appears that the Stated Issues were

resolved for the majority of individuals and families who submitted SOCs during the Public Disclosure. Review of the table confirms that concern associated with the Project has diminished. We cannot say for certain whether those that were originally against the Project are now satisfied or whether they simply elected to 'not submit' additional statements of concern. AST believes the answers to the SIRs will provide clarification to the authors of the SOCs submitted during the EIA public review period and may resolve the Stated Issues identified by these Authors.

B. Both fire chiefs are invited to the public consultation committee meetings, although typically only the chief for Lamont attends these meetings. We are not aware of any concerns that these individuals may have regarding training specific to the proposed sulphur forming and shipping facility. We will continue to attempt to use this committee to address issues that are addressed to the committee at that local level.

C. No air quality testing has been completed. A human health study was completed based on the air modelling results. These studies confirmed that no unacceptable human health issues are anticipated. This human health study and the air quality objectives used as reference points for the air quality assessment consider sensitive human receptors (i.e., those that may have respiratory ailments or sensitivities).

D. AST has not begun the tendering process for the Project.

E. The total taxes payable by AST are the same in both Volume IID, Section 4.4.3.2 and in Issue 27 of Table 5.7-1. The former section divides these taxes into the two major contributing sources in the tax estimate, land and buildings, and machinery and equipment. The latter table provides an estimate of how these taxes will be directed.

138. ***Volume IID, Section 5.6.6, Page 5-23, Appendix VI.***

a) *Provide meeting minutes for AST & Community Committee meeting minutes for meetings held subsequent to June 7, 2007.*

b) *In AST's opinion, are all the significant stakeholders, as identified in Appendix VI (see pages 2 and 3 of the Committee Mandate and Structure Development Worksheet prepared by RMC & Associates dated April 3, 2007), represented on the AST & Community Committee? If not, which stakeholders are not represented? Are there any significant stakeholders that have chosen not to work with the AST & Community Committee?*

A. A summary of the June 7th, 2007 meeting is attached (Attachment 8).

B. The following table illustrates the stakeholder groups identified in the *Committee Mandate and Structure Development Worksheet* that are and are not represented on the AST & Community Committee.

Stakeholder Group	Represented on AST & Community Committee	Not represented on AST & Community Committee
Residents that reside within 1.5 km of the proposed facility Site	✓	
Community members at large (beyond 1.5 km)	✓	
Town of Lamont elected officials or administrators	✓	
Town of Mundare elected officials or administrators	✓	
Town of Bruderheim elected officials or administrators		x
Friends of Lamont County	✓	
Lamont County	✓	
Emergency Response & Safety (Bruderheim and Lamont Fire Chiefs)	✓	
Local industry	✓	
Parent Advisory Committee		x
Lamont Health Care Centre		x
Fort Saskatchewan Air Partnership		x
Northeast Region Community Awareness & Emergency Response (NRCARE)	✓ NRCARE member represented on committee	
NorthEast Capital Industrial Association (NECIA)	✓ NECIA member represented on committee	
Elk Island Public Schools		x
Family & Community Services	✓ Represented by	

Stakeholder Group	Represented on AST & Community Committee	Not represented on AST & Community Committee
	Lamont County	
Friends of Elk Island		x
Alberta Industrial Heartland		x
Alberta Environment and/or Natural Resources Conservation Board		x
AST/HAZCO	✓	
WorleyParsons Komex	✓	

Operating on the principle of inclusivity as well as the belief that stakeholders self-define whether they are an interested party or not, both HAZCO/AST and the Facilitation Team (RMC & Associates) developed this list of potentially interested parties. The Committee's membership was subsequently reviewed with local stakeholders to gather their views on other potential parties. None were identified through this process.

As demonstrated in the Consultation Report and in the Two Month Updates on Consultation Activities submitted to Alberta Environment, contact was made either in person or by phone with a representative from each stakeholder group. All were invited and provided the opportunity to participate in the AST & Community Committee process. Meeting dates were identified through a community member polling process in an effort to eliminate scheduling conflicts.

To accommodate those that were invited to participate in the AST & Community Committee process but have not participated, HAZCO/AST provided a number of other consultation methods such as an Open House, one-on-one visits, telephone communication, offers to meet in person sent by letter, Newsletter Volume I, Newsletter Volume II and the Environmental Impact Assessment Information Forum as well as a local information office in Town of Lamont.

Finally, the AST & Community Committee remains open to new members and interests should these be identified or expressed by other organizations or persons.

1.12 WATER ACT APPLICATION

139. ***Volume IIB, Executive Summary, Section 3, Page 1-iv****. AST states "Water levels will be continuously monitored in the wetland in the northwest corner of the Site to validate the assessment made in the EIA".*

a) *Provide details of the continuous monitoring of water levels and quality in the wetland and the monitoring of the impact of the effects on the marginal wetland that will be implemented by AST during the groundwater diversion.*

b) *Explain how the monitoring relates to the Project's identified potential sources of contamination.*

A. This statement is not correct and should read that water levels will be regularly monitored in the wetland in the northwest corner of the property. This monitoring will be completed twice yearly as part of the groundwater monitoring program. Both water levels and water quality in the wetland will be determined during these discrete monitoring events.

B. Potential contaminants will be measured as part of the water quality testing. Potential contaminants in this case are primarily related to sulphur, which is expected to oxidize to sulphate if it is released into the environment.

Monitoring programs will take into consideration all potential sources of contamination by testing and complying with the generic criteria below:

- no visible sheen
- 6<pH,9
- COD <50 mg/L
- chloride <500 mg/L
- TSS <50 mg/L

As release is only anticipated during extreme run off conditions, pH and TSS are the most relevant indicators of potential facility related impact.

140. ***Volume IIB, Section 2.5.6.1, Page 2-28.*** *The addition of acidity to groundwater from the sulphur forming facility, may have a significant influence on groundwater quality in the LSA, and has a potential of impacting domestic water well users located downgradient of the proposed Project.*

a) *Provide the details of this proposed monitoring program in terms of when it will begin and end, the number of wells, locations of monitoring sites and anticipated completion details.*

b) *Describe plans to collect additional baseline chemical data to characterize the variability and average water quality values of important chemical parameters for evaluation of potential spills, leaks or unanticipated changes in water quality due to changes in hydraulic flow patterns in the LSA.*

c) *Confirm that dissolved metals will not be a groundwater quality issue in the LSA.*

A. In the EIA it was determined that measurable effects to soil quality over the 25 year lifetime of the Project (with possible secondary consequences for groundwater quality) will be confined to the PDA. Combined with calculated groundwater travel times on the order of hundreds of years or more to nearest domestic wells, it is reasonably concluded that ample response time is available for specific management measures to be implemented should significant impacts be detected by the groundwater monitoring program. The proposed monitoring program is described in Volume IIB, Section 2.9. The text provided below is extracted from this section.

'It is proposed that existing groundwater monitoring wells completed in the surficial deposits and upper bedrock at the PDA (i.e., "A" and "B" series wells; Figure 2.4 2), be monitored twice annually to evaluate potential effects to groundwater quantity (i.e., water levels) and quality. The monitoring program will be adaptively managed to ensure that it adequately reflects understanding of the local hydrogeology and possible effects related to the operation of the proposed facility.'

Upon Project approval groundwater monitoring would begin to collect additional baseline groundwater quantity and quality data prior to construction and operation, and to characterize variability and average values for physical and chemical data. Upon Project closure, groundwater monitoring would continue until it has been confirmed that any residual groundwater quantity or quality impacts from the Project have dissipated or until it can be shown that these residual impacts no longer pose a risk to the aquatic environment or nearby well users.

Upon Project approval, the design of the monitoring network and monitoring schedule would be submitted to AENV for review, comment and approval.

B. Baseline groundwater chemistry is described in Volume IIB, Section 2.5.6 of the EIA. A groundwater characterization report was also submitted with the original Application for the facility. There is currently no plan to collect additional baseline chemical data. Biannual groundwater monitoring would resume upon Project approval to collect additional baseline chemical data prior to operation.

C. In our opinion, metals contamination is not expected to be an issue at this facility. The AENV publication, "Phase 1 Environmental Site Assessment Guideline for Upstream Oil and Gas Sites" (AENV, 2001), was reviewed as it outlines contaminants commonly found at upstream oil and gas sites. According to this document, soluble metals may be a contaminant of concern associated with sulphur storage facilities, and hence metals would be included in the groundwater monitoring, at least initially. Baseline dissolved metal concentrations have been analyzed for the Site (Volume IIB, Section 2, Appendix IV).

141. ***Volume IIB, Section 2.6.6, Page 2-39.*** *AST states that "groundwater monitoring wells completed in the surfical deposits and the upper bedrock sandstone aquifer within the PDA will be monitored twice annually to evaluate impacts to groundwater levels".*

a) *Develop a Groundwater Management Plan (GMP) for the Project operations to address groundwater monitoring and investigation.*

b) *Provide information on how AST plans to verify, delineate, quantify, evaluate and mitigate any groundwater contamination issues that may arise during the Project's expected lifetime.*

c) *Provide a list of selected indicator parameters to be used in groundwater assessment.*

A. The GMP will include measures to minimize the risk of releases of substances that could otherwise affect water quality. These measures will include, but will not necessarily be limited to, the following:

- implementing safe construction and operational work procedures to reduce the potential for accidental spillages/collisions/emissions on Site during the construction and operational phase;
- developing an Emergency Response Plan to establish response procedures for potential accidental/catastrophic events;
- storing and handling potentially hazardous materials in accordance with provincial requirements;
- implementing sound management practices to minimize generation of fugitive dust;
- collecting runoff from the sulphur forming and storage areas in a perimeter ditch, lined with high density polyethylene (HDPE), that feeds into the surface water runoff pond;
- ensuring the capacity of the surface water runoff pond exceeds the volume of runoff generated by the 1 in 25 years, 24 hour rainfall event to prevent accidental release/breakthrough;
- ensuring the pond is double-lined (60 mil HDPE liner over compacted clay soil) and includes a leak detection system;
- recycling and reusing runoff collection water where possible to minimize requirements for controlled releases from the pond;
- neutralizing, monitoring, sampling and testing the runoff collection water prior to release, when a controlled release is required;
- ensuring the initial sulphur load-out and transfer tank is an in-ground concrete tank surrounded by a permeable leak detection system and secondary compacted clay soil liner;
- implementing liquid sulphur storage tanks including leak detection systems; and
- constructing an asphalt storage pad for sulphur pastilles including primary asphalt containment, a secondary clay soil liner, runoff and run-on controls and a leak detection system.

As part of the GMP, existing groundwater monitoring wells completed in the surficial deposits and upper bedrock at the PDA (i.e., “A” and “B” series wells; Figure 2.4 2) will be monitored twice annually to evaluate potential effects to groundwater quantity (i.e., water levels) and quality. Additional groundwater investigations would be initiated in the event that this routine monitoring detects an impact that may eventually become unacceptable. These groundwater investigations would follow guidelines set out by the AENV (e.g. “Phase 1 Environmental Site Assessment Guideline for Upstream Oil and Gas Sites”; AENV, 2001). Should unacceptable impacts be confirmed (i.e., the Site is considered contaminated according to applicable guidelines), then appropriate mitigation measures will be undertaken. Depending on the level of impact, these mitigation measures could include monitored natural attenuation, risk assessment or intervention (remediation).

B. Groundwater contamination would be verified and quantified by comparing chemistry data from routine monitoring against baseline groundwater quality. A groundwater quality impact would be defined as a chemical concentration that is statistically significant above baseline variability in the water quality parameter. Groundwater quality impacts would be determined using trend charts and statistical analyses for select indicator parameters. Groundwater quality impacts would be delineated and evaluated through the installation of additional monitoring wells in the impacted area. Depending on the level of impact, mitigation measures could include monitored natural attenuation, risk assessment or intervention (remediation).

C. The AENV publication, "Phase 1 Environmental Site Assessment Guideline for Upstream Oil and Gas Sites" (AENV, 2001) was reviewed, as it outlines contaminants commonly found at upstream oil and gas sites. According to this document, sulphur storage facilities may be associated with salinity, sulphur, sulphates, pH, soluble metals and inorganics. As such, it is proposed that the analytical schedule for monitoring of the sulphur facility will include temperature, pH, electrical conductivity, select inorganic indicator data including dissolved sulphate (similar to baseline characterization suite; Volume IIB, Section 2, Appendix IV of EIA) and dissolved metals. Analysis of dissolved metals was not included in the original monitoring program submitted as part of the EIA.

142. ***Volume IIB, Sections 2.6.5 and 2.6.9.1, Pages 2-39 and 2-40.*** *AST states that by using theoretical drawdown values it was concluded that "effects of water withdrawals on existing water users should remain negligible or low in magnitude for the entire 25 year duration of the Project."*

a) *Provide a groundwater monitoring program which includes the monitoring of potential effects to the domestic wells and allows for verification of this prediction.*

A. The proposed monitoring program for groundwater beneath and around the PDA is described in Volume IIB, Section 2.9. The underlying text is extracted from this section. AST would be happy to include all neighbouring domestic supply wells in the monitoring program, subject to those residents agreeing to allow access. It is noted that the rate that water is extracted from these wells is not typically recorded; hence, it may not be possible to correlate water levels in these wells to Project operations.

'It is proposed that groundwater monitoring wells completed in the surficial deposits and upper bedrock at the PDA (i.e., "A" and "B" series wells; Figure 2.4 2), be monitored twice annually to evaluate potential effects to water levels. The monitoring program will be adaptively managed to ensure that it adequately reflects understanding of the local hydrogeology and possible effects related to the operation of the proposed facility.

Upon Project approval, the design of the monitoring network and monitoring schedule would be submitted to AENV for review, comment and approval.'

1.13 ERRATA

143. ***Volume Application, Section 5.5, Table 3.*** *Table 3 indicates that for Item d "building location and type" the information can be found in Figure 4, however, this Figure 4 shows the Potential*

Development Area (PDA) but buildings are not discernable. Table 3, Item d, should refer to Figure 5 which shows the plot plan and buildings.

The error is acknowledged and any future versions of the document issued will reflect this correction.

144. ***Volume IIB, Section 2.5.1.7.2, Table 2.5-11, Page 2-34.*** *Several data entries in this table appear to be incorrect. Specifically, the CEC for Soil Map Unit DUG (i.e. Black Solonetz) is recorded as 4,111 meq/100 g. As well, the CEC for the Soil Map Unit HYL2 (i.e. Rego Humic Gleysol) is recorded as 211 meq/100 g.*

a) *Provide the corrected values.*

Table 2.5-11: Sensitivity ratings for soil map units in the LSA

Soil Map Unit	Inspection Site Number	pH (units)	CEC (meq/100g)	Sensitivity Ratings[1]			
				Base Loss	Acidification	Aluminum Solubilisation	Overall Sensitivity[1]
AGS	31	6.2	24.0	L	L	L	L
CMO	11	5.0	22.7	M	L	H	M
DUG[2]	15	5.11	41.0	M	L	M	M
HBM	4	6.0	20.9	L	L-M	L-M	L
HGT	13	6.2	34.4	L	L	L	L
HYL[2]	50	7.7	21.0	L	L	L	L
MNT	17	n/a	n/a	L-M	L	n/a	L
PHS	12	5.7	13.1	M	L-M	L-M	M
PHS	33	5.6	16.4	L	L-M	L-M	L
POK	1	6.3	26.9	L	L	L	L
POK	52	7.2	21.6	L	L	L	L
WKN	3	5.8	24.5	L	L-M	L-M	L
WKN	16	6.8	24.0	L	L	L	L
Reclaimed	29	7.6	17.9	L	L	L	L
Reclaimed	35	7.6	19.6	L	L	L	L
Reclaimed	44	7.9	21.9	L	L	L	L

Notes:

[1] Sensitivity ratings determined using the methods outlined in Holowaychuck and Fessenden (1987) for mineral soils or Turchenek, (1998) for organic soils.

[2] Analytical data obtained from AGRASID (2001) Soil Layer File.

N/A – parameter is not applicable or not used for rating organic soils (Turchenek, 1998).

145. ***Volume IIB, Section 4.4.3.2, Figure 4.4-1, Pages 4-22 to 4-24.*** *The numbers shown in Figure 4.4-1 do not agree with those in the narrative.*

a) *The building and machinery costs show total $30 million rather than the $37.5 million identified in Section 4.4.2.2 of the narrative. Revise the narrative and Figure 4.4-1 accordingly.*

b) *Figure 4.4-1 shows total taxes estimated at $345,183 while the narrative states that the amount is $460,077. Revise the narrative and Figure 4.4-1 accordingly.*

A. The total construction costs should be identified as $37.5 million in Figure 4.4-1.

B. The total taxes should be identified as $460,077 in Figure 4.4.-1.

146. ***Volume IIB, Section 4.5.2.1, Page 4-24.*** *Sediment sampling locations identified as SW3, SW1 and SW4 are in error. SW denotes a surface water sampling location. Therefore, SW should be replaced with SED.*

The error is acknowledged and any future documents issued will reflect this correction.

147. ***Volume IIC, Section 5.3.3.5.1, Page 5-7.*** *The first paragraph in this section uses a definition from a well known biodiversity reference to define species richness as including the total number of mammal, bird, or vascular and non-vascular plant species identified for a given area.*

a) *Did AST mean to indicate that species richness typically includes those species groups, but in fact could consider a much wider range of taxa, including invertebrates?*

A. That is correct. Biodiversity includes all forms of life; however, in the context of this environmental assessment, only the taxa mentioned above are considered.

148. ***Volume IID, Section 2.5.3, Page 2-13.*** *AST makes reference to a primary highway being a "secondary road", this could cause some confusion as effective 2000 all secondary roads were assumed by the Province and designated as "primary highways" which carry certain requirements, funding, administration, and jurisdiction defined by Legislation. Update this section and all other sections accordingly.*

The error is acknowledged and any future versions of the document issued will reflect this correction.

1.14 NRCB

The questions below specify additional information requested by the NRCB to complete their evaluation of the EIA report and application. The responses to these questions will not be considered as part of the completeness decision made by Alberta Environment.

149. **Volume I, Appendix V, Page V-1.** AST states, "*The plan was developed to identify response organizations, and command and control structures as laid out in the ICS*."

a) *What is the hierarchy for emergency response for incidents that occur on Site?*

b) *What is the composition of the emergency response organization?*

c) *What are the roles and responsibilities of personnel within the organization?*

d) *What are the command and control structures?*

e) *The term Incident Site Manager (ISM) is used on page V-7. If the ERP intends to follow ICS, why is the term 'Incident Commander' not used for the lead individual at the incident site? Will the term Incident Command Post be used?*

A. The hierarchy for the emergency response for incidents that occur on site follow the procedures outlined in the ERP in Volume I, Appendix V, Section 3: Communication. This question is interpreted as asking how an incident will be communicated through the hierarchy

of the facility and outwards into the broader community. The employees of the facility will be trained to follow the communication requirements associated with each level of emergency outlined in Section 3 which is pasted below for convenience:

"3.1 Internal Communications

Communication between the Incident Site Manager (ISM) and Emergency Operations Centre (EOC) should follow the protocol shown in Figure V-4. The primary communication from the ISM to the EOC should be by two-way radio on assigned frequencies. The first alternate is cell phone with the second alternate being is telephone landlines. Communication from the Site EOC to the corporate EOC will be priority telephone landline and alternately cell phone.

3.2 External Communications

Communications between the EOC and external agencies including government regulators are as follows:

- NR CAER and all responding mutual aid assistance:
- primary method is two-way radios utilizing NR CAER frequency
- secondary method is telephone landline followed by cell phone
- all others including government:
- primary method – telephone landline
- secondary method – cell phone

3.3 Protocol

Communication between the ISM and EOC should employ the same point of contact to ensure consistency. When radios are the primary means of communication, audio traffic will be concise and direct as required by the radio-telephony license.

3.4 Alerting and Activation

Emergency levels in this section are categorized according to the EUB Directive 071 Criteria Matrix for Classifying Incidence (see Figure V-5) which includes an alert state followed by three emergency levels. The emergency levels range in ascending order of severity from Level 1 to Level 3. Each level has a different response matrix and a guide on moving from one level to the next."

	Incident	Emergency		
Responses	**Alert**	**Level 1**	**Level 2**	**Level 3**
Communications				
Internal	Discretionary, depending on licensee policy	Discretionary, depending on licensee policy	Immediate notification of off Site management	Immediate notification of off Site management
External Public	Courtesy at licensee discretion	Mandatory for individuals within the EPZ requiring notification	Planned and instructive as per the specific ERP	Planned and instructive as per the specific ERP
Media	Reactive, as required	Reactive, as required	Proactive – media management to local or regional interest	Proactive – media management to local or regional interest
Government	Notify EUB if public contacted	Notify EUB. Call local authority and RHA, if public or media is contacted	Notify EUB and local authority	Notify EUB and local authority
Actions				
Internal	On Site, as required, by licensee	On Site, as required, by licensee. Initial response undertaken in accordance with the specific or corporate-level ERP	Predetermined public safety actions are underway. Corporate management team alerted and may be appropriately engaged to support on-scene responders.	Full implementation of incident management system
External	On Site, as required, by licensee	On Site, as required, by licensee	Potential for multi-agency (operator, municipal, provincial or federal) response	Immediate multi-agency (operator, municipal, provincial or federal) response
Resources				
Internal	Immediate and local. No additional personnel required	Establish what resources would be required	Limited supplemental resources or personnel required	Significant incremental resources required
External	None	Begin to establish resources that may be required	Possible assistance from government agencies and external support services as required	Assistance from government agencies and external support services as required

Source: EUB 2003

Figure V-1: Communications Protocol

Summary of Qualitative Measures of Consequence or Impact		
Level	**Descriptor**	**Example of Detail Description**
1	Minor	No injuries, limited and localized environmental impact, low financial loss ($50,000), nil press interest. First Aid treatment, on Site release contained with outside assistance, short-term, temporary environmental impact, low press interest.
2	Moderate	Medical treatment required, on Site release contained with outside assistance, medium environmental impact, local and possibly regional media interest publicity.
3	Major	Public safety jeopardized, off Site release with significant and ongoing environmental impact, adverse national publicity
4	Catastrophic	Fatality, toxic pollution and off Site contamination with long-term environmental impact, national and international publicity

Qualitative Measures of Likelihood		
Level	**Descriptor**	**Description**
1	Unlikely	• Incident contained/controlled • No change of additional hazards • Ongoing monitoring required
2	Moderate	• Imminent control of the hazard probable
3	Likely	• Uncontrolled incident • Operator has capability to manage and control incident
4	Almost Certain or Currently Occurring	• Uncontrolled incident • Little change hazard will be controlled in the near future • Assistance from outside parties required
What is the likelihood that the incident will escalate, resulting in an increased exposure to public health, safety or the environment?		

Risk Levels Based on Likelihood and Consequences					
Risk Assessment Map					
Consequences	**Minor (1)**	2	3	4	5
	Moderate (2)	3	4	5	6
	Major (3)	4	5	6	7
	Catastrophic (4)	5	6	7	8
		Likely (1)	**Moderate (2)**	**Likely (3)**	**Almost Certain (4)**
		Likelihood			

Control Considerations	
Risk Level	**Assessment Results**
Very Low 2–3	**Level 0 (Alert)** No action required
Low 4–5	**Level 1 Emergency** There is no danger outside company property or ROW. The situation can be handled entirely by company personnel. • Immediate control of the hazard/source is possible • No threat to public • Minimal environmental impact • Little or no media interest
Medium 6	**Level 2 Emergency** Potential for the emergency to extend beyond company property. Imminent control of the situation is probable; some threat to the public, moderate environmental impact; local regional media interest.
High 7–8	**Level 3 Emergency** • Uncontrolled hazard • Public safety jeopardized • Significant ongoing environmental impact • Significant media interest • Immediate municipal and provincial government involvement • Assistance from outside parties required

Source: EUB 2003

Figure V-2: Criteria Matrix for Classifying Incidence

B. The emergency response organization of the facility will mirror the facility management organization. A Lead Operator will be assigned to be responsible for facility operations during a given shift. That Lead Operator will be responsible for emergency response coordination and execution on Site. A second operator will be assigned to take charge of the facility (operations as well as in emergency conditions) if the Lead Operator is not capable of responding. The role of a corporate centre would be to assist in communicating with local emergency response capability in the event of an emergency. The response organization and structure for emergencies requiring the assistance of the local response organizations would follow that organization's structure if and when those organizations become involved.

C. See Answer B.

D. The command and control structure mirrors the structure of the facility personnel. A supervisor of the facility is ultimately in charge and responsible for the emergency response. The lead operator is the individual responsible for first response if the supervisor is not on Site at the time of the emergency. A second operator will be designated to take charge if the lead operator is not capable of leading the response team.

E. The term "Incident Commander" will be used instead of "Incident Site Manager. Emergency Operations Center (EOC) will be used instead of Incident Command Post.

150. **Volume I, Appendix V, Figure V-1, Page V-3.**

a) *What residences are within the Call Out Zone for Worst-Case Scenario – SO_2 Release of 5 ppm?*

b) *Is it possible that an SO_2 release could exceed 5ppm? How would that affect the Call Out Zone?*

c) *How will the different planning zones (i.e. the EUB's 'Emergency Planning Zone', 'Emergency Awareness Zone', 'Initial Isolation Zone', and 'Protective Action Zone') for specific incidents be referenced? Outline the specific actions and considerations for each zone.*

A. Figure 150-1 shows the locations of residences within the Call Out Zone. Table 150-1 provides a partial list of landowners located within the Call Out Zone based on information gathered from the 2006 Lamont County Ownership Map. A complete list of landowners and residences located within the Call Out Zone for Worst-Case Scenario – SO_2 Release of 5 ppm will be compiled when the Final Emergency Response Plan is developed for the Project. The residences will be registered with the NR CAER Automated Emergency Dial-out Program.

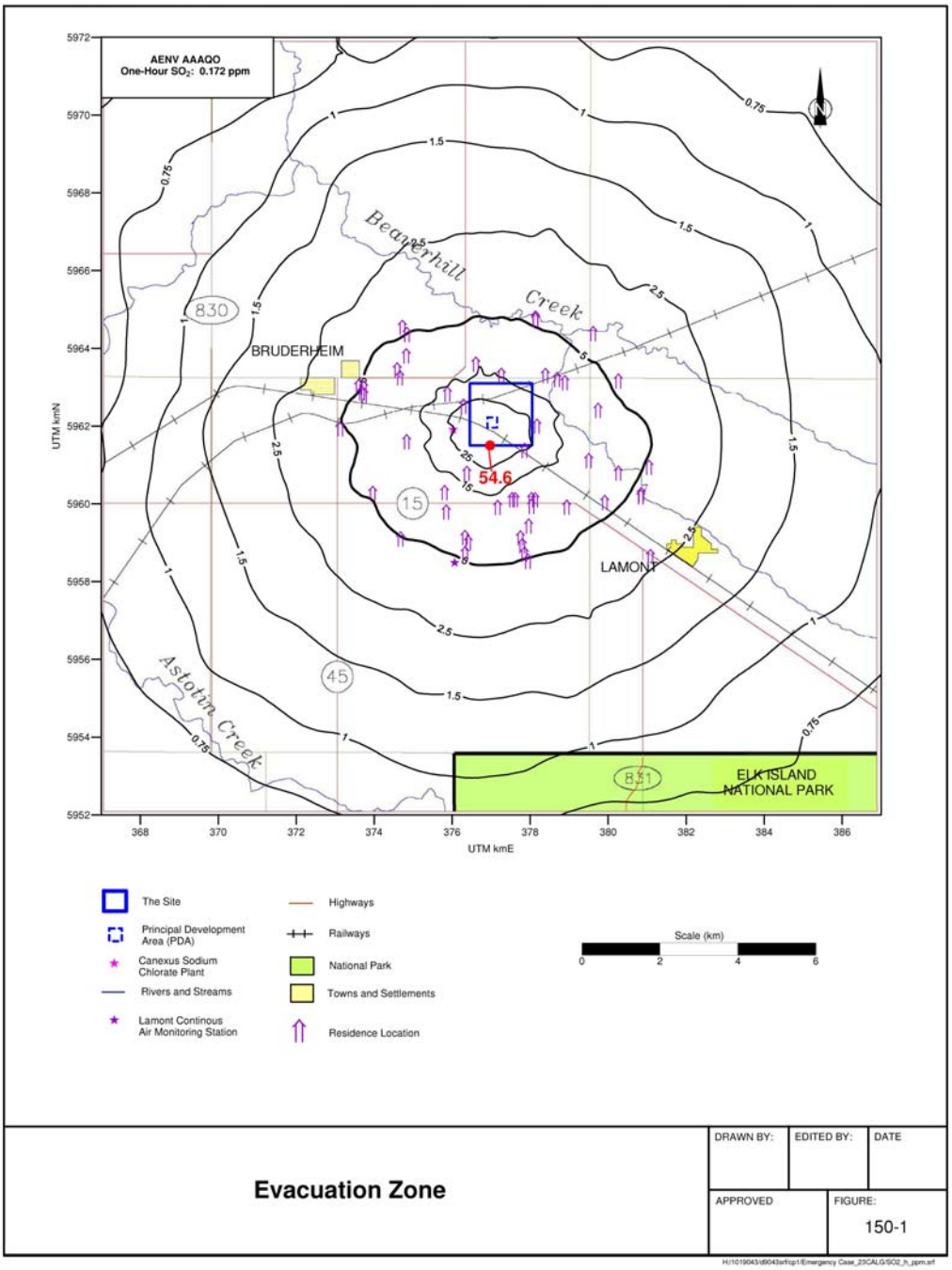


Figure 150-1: Location of residences within the Call Out Zone

Table 150-1: Partial List of Landowners Located within Call Out Zone

Company Name / Title	Title	First Name	Last Name	First Name	Last Name	PO Box	Address	City	Province	Postal Code
		Stanley	Arndt	Marlene	Arndt	155		Bruderheim	AB	T0B 0S0
		Timothy	Bartz	Cynthia	Peterson	421		Bruderheim	AB	T0B 0S0
		Rodger	Bartz	Jennetta	Bartz	76		Bruderheim	AB	T0B 0S0
		Dean	Bartz			76		Bruderheim	AB	T0B 0S0
		Marvin	Bartz	Elsie	Bartz		7307-137 Avenue	Edmonton	AB	T5C 2L4
		Jason	Boon	Tara	Boon	181		Bruderheim	AB	T0B 0S0
		Frank	Cholak	Elly	Cholak	86		Lamont	AB	T0B 2R0
		Glen	Fibke	Sarah	Fibke	96		Bruderheim	AB	T0B 0S0
		Ted	Frauenfeld				9230 - 94 Street	Edmonton	AB	T6C 6V5
		Ruth	Hauer			368		Bruderheim	AB	T0B 0S0
		Wesley	Hauer	Elfrieda	Hauer	88		Bruderheim	AB	T0B 0S0
		Roy B.	Hauer							
		Robert	Kottke			553		Bruderheim	AB	T0B 0S0
		Stewart	Maschmeyer	Angela	Maschmeyer	188		Bruderheim	AB	T0B 0S0
		Audrey	Maschmeyer			188		Bruderheim	AB	T0B 0S0
		Douglas	Mccartney			761		Lamont	AB	T0B 2R0
		Jeff	Mcneill	Laurie	Mcneill	637		Lamont	AB	T0B 2R0
		Cyril	Paul	Wanda	Paul	195		Bruderheim	AB	T0B 0S0
		Herbert	Rinas	Audrey	Rinas		12 Century Villa Close	Fort Saskatchewan	AB	T8L 4G7
		Barry	Schram	Laverne	Schram	494		Bruderheim	AB	T0B 0S0
		Brenda	Schultz				92 Westwood Lane	Fort Saskatchewan	AB	T8L 4N8

Company Name / Title	Title	First Name	Last Name	First Name	Last Name	PO Box	Address	City	Province	Postal Code
		Jerry	Strand	Rosemary	Strand		46 Mcmullough Crescent	Red Deer	AB	T4R 1S7
		Neil	Woitas	Roseanna	Woitas	327		Bruderheim	AB	T0B 0S0
1038103 Alberta Ltd.	President	Pat	Dietrich				3116 - 40 Street S.W.	Calgary	AB	T3E 3J8
Canexus Chemicals Canada Ltd.	Plant Manager	John	Kirichenko			100		Bruderheim	AB	T0B 0S0
Churchill Ind Group	Chairman	Peter	Adams				12836 – 146 Street	Edmonton	AB	T5L 2H7
Town Of Lamont	Mayor	Rick	Koroluk				5303 - 50 Avenue	Lamont	AB	T0B 2R0
Superior Plus Inc. (Erco Worldwide)	Manager New Product Development			Now: Alter Nrg		278		Bruderheim	AB	T0B 0S0
Shriners Hospitals For Children										

B. According to the results of the Air Modelling the worst case scenario for SO_2 release is 5 ppm. It is unlikely that a higher concentration of SO_2 would be released from the facility. A broader notification would occur at this unlikely event, taking into account the nature of the release, the prevailing wind direction, and measured concentrations of SO_2 on the ground.

C. The different planning zones (i.e., the ERCB's 'Emergency Planning Zone', 'Emergency Awareness Zone', 'Initial Isolation Zone', and 'Protective Action Zone') for specific incidents will be referenced following the guidelines of Directive 071 (ERCB 2007). It is noted that there is essentially no risk of an H_2S release (as is contemplated by Directive 071) but that risk to the public during an emergency is associated only with release of SO_2 during a sulphur fire. In addition, the evacuation zone depicted in Figure V-1 was modelled following EUB ID 2001-5 for evacuation limits related to SO_2 concentrations.

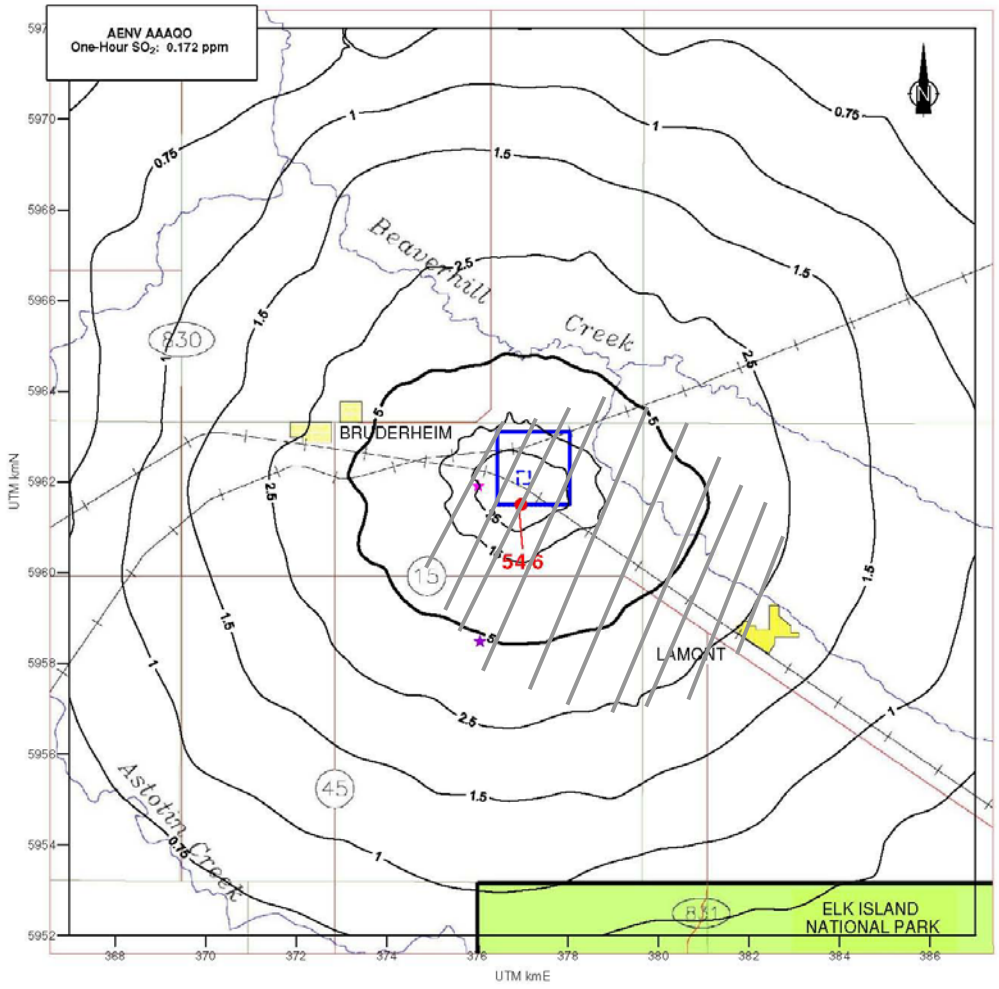
   The specific actions and considerations for each of the ERCB defined zones are outlined below:

   i) Emergency Planning Zone (EPZ): the evacuation zone associated with the worst case scenario as shown in Figure V-1 will be designated the EPZ . Modifications to the EPZ will be considered based on information gathered during the Public Involvement process to be conducted if the Project is approved and when the final ERP is drafted and submitted for approval.

   ii) Emergency Awareness Zone (EAZ): the EAZ is an area outside of the EPZ where public protection measures may be required. The EAZ with be established as part of the final ERP in consultation with local authorities, local first response groups, and the public. AST does not anticipate potential impacts from the worst case scenario will extend beyond the EPZ.

   iii) Initial Isolation Zone (IIZ): the IIZ will encompass an area in close proximity to the Project where indoor sheltering may provide limited protection due to proximity of continuous SO_2 release during a worst case scenario. The IIZ is limited to the Site proper and the facilities located on the Site. The muster and first response processes described in the ERP comprise the considerations and response processes for the IIZ. Based on the SO_2 dispersion modelling completed for the worst case scenario, the IIZ would not extend off the Site proper and hence would not include area residents.

   iv) Protective Action Zone (PAZ): the approximate size and direction of the SO_2 plume immediately following the release of SO_2 will be determined by site personnel using monitoring tools and wind direction. The initiation of public protection measures in the PAZ will follow the recommendations of Directive 071.



Legend

The Site		Highways	
Principal Development Area (PDA)		Railways	
Canexus Sodium Chlorate Plant		National Park	
Rivers and Streams		Towns and Settlements	
Lamont Continuous Air Monitoring Station		Call Out Zone for Worst-case Scenario – SO_2 Release of 5 ppm (EUB ID 2001-5)	

Scale (km) 0 2 4

Figure V-1: Evacuation Zone

151. ***Volume I, Appendix V, Section 3.2, Page V-7.***

a) *Provide a list of all of the organizations that need to be notified during each Level of Emergency (i.e. Emergency services, Transport Canada…).*

b) *What position(s) within the EOC are responsible for external communications?*

c) *Who is responsible for communicating with the public and media during an incident?*

A. The list of all organizations that need to be notified during each Level of Emergency will be compiled in the Final Emergency Response Plan to be developed for the Project. The current understanding of organizations that require notification include the following:

Level I: HAZCO, CCS Corporate

Level II: above plus Lamont and Bruderheim first response (local fire, paramedic, police)

Level III: above plus NR CAER member companies and response organizations

B. The Lead Operator is responsible for implementing external communications protocols. The Lead Operator may delegate this task to an on Site person or to a corporate representative.

C. The corporate centre will communicate with the public and media during an incident.

152. ***Volume I, Appendix V, Section 3.4, Page V-7***

a) *Under what circumstances does the EOC get activated?*

b) *Who is responsible for declaring the Level of Emergency? For escalating and decreasing the Level of Emergency?*

c) *Under what circumstances is support from corporate headquarters asked for or provided?*

A. The EOC will be activated at every Level of Emergency to ensure the safety of operations personnel and residents in the high-risk area at all times.

B. The Lead Operator is responsible for declaring the Level of Emergency and for modifying the Level of Emergency as the situation decreases or escalates. This responsibility is transferred to the local fire departments if the incident level is elevated to Level II.

C. Corporate headquarters will be notified of any circumstance that activates the EOC and the Lead Operator will evaluate when specific assistance is required from corporate headquarters.

153. ***Volume I, Appendix V, Section 3.4.1, Page V-10.***

a) *What is the contact information for neighbouring industries that could provide assistance in an emergency?*

b) *Where will the contact information for residents within the Call Out Zone be located, and who has access to those numbers?*

A. The contact information for neighbouring industries that could provide assistance in an emergency is managed through the NR CAER process and is compiled as a component of the project development and approval.

B. The contact information for residents within the Call Out Zone will be located with NR CAER. Residents in the high risk zone will automatically be contacted in the event of an emergency via the NR CAER Automated Emergency Dial-Out Program.

154. ***Volume I, Appendix V, Section 4.2, Page V-11.*** *AST states "If the building alarm sounds, a minimum of two operations personnel must check the area."*

a) *Are the two operations personnel pre-designated? If not, who designates them to check the area?*

b) *Who gives direction to the operations personnel during the response?*

A. The Lead Operator will designate the two operations personnel. They are not pre-designated. One of the individuals will be identified as the emergency rescue team leader for the purpose of completing the rescue.

B. The Lead Operator will give the directions to the operations personnel during the response.

155. ***Volume I, Appendix V, Section 5.2.4, Page V-12.***

a) *With the Emergency Evacuation Practice and emergency event alarms being the same, how do site personnel determine whether the alarm is a real emergency or a drill?*

A. The criteria for evacuation to the Muster Station are the same during an Emergency Evacuation Practice and emergency event. Site personnel are informed of the test both prior to and following sounding of the alarm. That way they know it is a test alarm.

156. ***Volume I, Appendix V, Section 5.3.1.3.5, Page V-15***

a) *What emergency medical certification will members of the emergency rescue team have?*

A. Standard emergency response preparation training and current certification would include the following:

a. Advanced First Aid;

b. Advanced Fire Fighting;

c. Confined Space entry

d. H_2S Alive; and

e. WHMIS.

157. **Volume I, Appendix V, Section 5.3.1.3.6, Page V-16.** AST states "*If an alternate muster point is used, advise the Control Room Incident Commander.*"

a) *Will there be pre-designated muster points created in addition to the emergency muster point in the Control Room?*

A. Safe evacuation to an alternate muster station would occur if safe evacuation to the assigned Muster Station were not possible. Alternate pre-designated muster points will be created to

reflect possible changes in wind direction in the event that it is unsafe to assemble at the Muster Station.

158. **Volume I, Appendix V, Section 11, Page V-32**

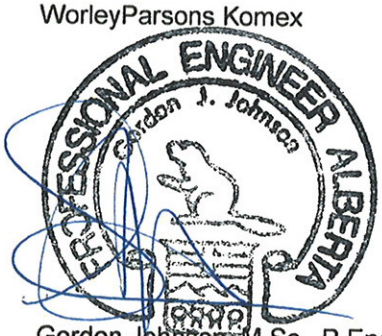
a) *Who is responsible for addressing issues identified in the Post Emergency Analysis and Debriefing?*

b) *Who is responsible for filling out this Form?*

A. The facility supervisor is responsible for addressing issues identified in the Post Emergency Analysis and Debriefing.

B. The facility supervisor is responsible for completing this Form.

Sincerely,
WorleyParsons Komex



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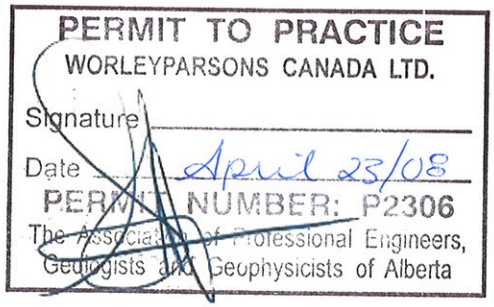
Global Lead - Environment



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Energy Resources Conservation Board (ERCB). 2007. Directive 071: Emergency Preparedness and Response Requirements for the Petroleum Industry. December 2007.

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Attachment 1 : Design Basis Memorandum

WorleyParsons MEG

ALBERTA SULPHUR TERMINALS LTD. - HAZCO
BRUDERHEIM SULPHUR FORMING & STORAGE FACILITY
WORLEYPARSONS MEG PROJECT # 085433
PROCESS DESIGN BASIS

DOCUMENT DISTRIBUTION

Client	WorleyParsons MEG
Murray Propp	Greg Otterson
Rob Mann	Gary Ling
	John Chapman
	Pat Rondilla
	Len Jankowski
	Henry Yuen

DOCUMENT REVISION HISTORY

Rev	Date	Remarks	By	Checked	Approved
0	2005-07-19	Issued for Internal Review	GO		
1	2005-07-29	Issued for Estimate	GO		

Table of Contents

1.0 INTRODUCTION

WorleyParsons MEG Ltd. was commissioned to review a factored sulphur forming facility cost estimate that was prepared by Worley Parsons MEG Limited for Alberta Sulphur Terminals Ltd. (HAZCO) at the bid stage of their negotiations with a sulphur producer. The purpose of the review is to confirm that the estimate contains all of the major equipment that will be needed for the sulphur forming plant, and that the values in the estimate for the equipment costs are reasonable.

The process design basis serves to identify the equipment that is required for the sulphur forming facilty and to provide preliminary sizing data.

The facility will be designed to form 2700 MTPD of liquid sulphur, to be brought into the plant by combination of truck, rail, and pipeline. Initially, the feed to the forming facility will be supplied primarily by truck. A facility capacity of 3600 MTPD is to be supported by the utility and piping infrastructure where cost increases are not excessive.

Sandvik was selected by Alberta Sulphur Terminals to provide the forming technology known as Rotoforming. A detailed quotation was provided by Sandvik which outlined the utility requirements and serves as the basis for the entire estimate.

2.0 PHYSICAL PROPERTIES

This section outlines some of the basic properties of the fluids that are encountered in this process.

2.1 SULPHUR

Liquid Density: 1.79 MT / m^3 (111.7 lb / ft^3)

Melting Point: 113°C (235°F)

Heat of Fusion: 16.9 BTU / lb

Heat Capacity – Liquid: 0.23 BTU / lb °F

Heat Capacity – Solid: 0.82 BTU / lb °F

Thermal Conductivity: 0.27 W / m K (0.16 BTU / hr ft °F)

2.2 LOW PRESSURE STEAM

Nominal Pressure: 50 psig, up to 100 psig

2.3 COOLING WATER

Supply Temperature: 68°F

Return Temperature: 85°F

3.0 PROCESS DESCRIPTION

3.1 SULPHUR RECEIVING AND STORAGE

Molten sulphur is continuously supplied to the forming facility via truck. The trucked sulphur is gravity-loaded into the sulphur pit, T-100, on a twenty-four (24) hour per day and seven (7) day per week basis. Railcars are unloaded with the use of a pump, P-109, into the sulphur pit. It is expected that railcar unloading occurs at non-peak truck unloading times. Sulphur pit pumps, P-101 A/B, are used to transfer the molten sulphur from T-100 to a matrix of six (6) sulphur tanks, T-101 through T-106.

Connections at the discharge of P-101 A/B will allow for tie-ins from the molten sulphur pipeline.

The sulphur transfer pump, P-102, is utilized to transfer molten sulphur from the storage tanks to the Rotoforming Day Tank, T-107. From T-107 the Rotoforming Feed Pumps, P-103 A/B, feed molten sulphur to the Rotoforming feed header through a filter, F-101, and a sulphur cooler, E-101. The feed header is supplied with sulphur, 50% in excess of the rotoforming requirements, with a continuous recycle to T-107.

3.2 ROTOFORMING

The rotoforming section contains nine (9) Sandvik Rotoform HS Pastillators, each with a forming capacity of 12.5 MTPH. Each machine requires 68F cooling water at a rate of 228 usgpm. Cooling water is discharged from the rotoformer at a temperature of 85F. Each machine also has steam and condensate connections, sized to deliver 30,000 BTU/hr of heat duty to the rotoformer. In order to allow the solidified product to release from the cooling conveyer, a silicon solution is applied at a rate of 2 L / MT. Make-up water is required.

Rotoformer product sulphur is collected on CV-101, a collector conveyor and transported to CV-102, a radial stacking conveyer, where the product is moved to outdoor storage facilities.

The rotoforming section is designed to be expanded to twelve (12) machines without a major facility upgrade.

3.3 UTILITIES

The rotoforming facility includes the following utility systems:

- Cooling Water System – heat rejection to atmosphere via cooling towers
- Low Pressure Steam System (50 to 100 psig) – natural gas fired boiler
- Condensate System
- Water Make-up System – including water treatment
- Site Water System
- Firewater System

- Instrument Air System

4.0 EQUIPMENT SPECIFICATION

4.1 SULPHUR RECEIVING AND STORAGE

4.1.1 Sulphur Pit

T-100

The sulphur pit is sized for a capacity of 350 MT. Approximate dimensions are 4m wide by 16m long by 3m deep. Since there will be facilities in place to offload approximately four (4) trucks at a time, the sulphur pit is sized for approximately eight (8) truckloads of molten sulphur.

4.1.2 Sulphur Tanks

T-101 to T-106

The sulphur producer with whom Alberta Sulphur Terminals is entering into a contract, requires that molten storage be available for 72 hours at a rate of 1400 MTPD. As such, six (6) tanks have been specified, each with a capacity of 700 MT. These tanks are sized at 23.5 ft (7.16 m) diameter by 32 ft (9.75 m) height in order to be shop-built.

Storage tanks shall be equipped with steam coils and a minimum of 2" of external insulation. Tanks shall have 6" nozzles for inlet and outlet sulphur as well as 6" nozzles for two (2) atmospheric vents.

T-107

The sulphur day tank is sized for one (1) hour of holdup at the molten sulphur rate for twelve (12) Sandvik machines. With twelve (12) machines at 300 MTPD and a 50% recycle stream, the tank shall have a capacity of 225 MT. Approximate dimensions are 16 ft (4.88 m) diameter by 22 ft (6.71 m) height. It is expected that this tank will be shop-built.

The tank shall be equipped with steam coils and a minimum of 2" of external insulation. The tank shall have 6" nozzles for inlet and outlet sulphur as well as 6" nozzles for two (2) atmospheric vents.

4.1.3 Sulphur Pumps

P-101 A/S

The sulphur pit pumps are specified as two (2) 100% pumps, based upon the unloading of a maximum rate of eight (8) trucks per hour the sulphur pit. The pumps must be able to process 8448 MTPD (866 usgpm) at maximum rate. These pumps are crucial to the flow of sulphur into the facility and to the adherence of the contract with the sulphur producers, and have been specified with full sparing.

It is expected that these pumps will be the submersible type.

Although the expectation is to offload 300 MTPD of sulphur from railcars when the forming facility starts-up at 2700 MTPD, the sulphur pit pumps are designed to a maximum flowrate of eight (8) trucks per hour. It is assumed that railcar unloading will occur at off peak times.

The discharge pressure requirement of the P-101 A/B pumps is based on the maximum level in the T-101 to T-106 tanks in addition to the pressure drop in the line between the sulphur pit and the tankage area.

P-102

The sulphur transfer pump is specified as one (1) 100% pump, based upon the transfer of 3600 MTPD (369 usgpm) of molten sulphur to the T-107 day tank. A complete warehouse spare is maintained in the case that the P-102 pump stops working.

The discharge pressure requirement of the P-102 pump is based upon the minimum level in T-101 to T-106, the maximum level in T-107, and the line pressure drop between the tankage area and the day tank.

P-103 A/B

The rotoformer feed pump is specified as two (2) 50% pump, based upon the feed of 5400 MTPD (553 usgpm) of molten sulphur to the rotoformer feed header. The design rate is based upon 50% recycle of molten sulphur to the day tank. A complete warehouse spare is maintained in the case that either of the P-103 A/B pumps stops working. The reason that two pumps are specified is that the largest Viking positive displacement pump we have considered has a maximum rate of 480 usgpm. An alternative would be to provide a single 480 usgpm pump and reduce the recycle rate to 30%.

The discharge pressure requirement of the P-103 pumps is based upon the minimum level in T-107, a Sandvik machine sulphur pressure of 43 psig, and the line pressure drop between the day tank area and the rotoforming area.

P-109

The railcar unloading pump is specified as one (1) 100% pump, based upon unloading a 300 MT railcar in a 12 hour period. The required flowrate is 600 MTPD (62 usgpm). The P-109 pump will discharge into the sulphur pit.

It is expected that railcar unloading will be completed in off-peak truck unloading hours.

4.1.4 Filters

Two (2) 100% filters, F-101 A/B, are installed on the discharge of the P-103 pumps. The purpose of the filters is to remove particulates and carsul from the molten sulphur stream. Such impurities could cause misoperation within the forming equipment.

4.1.5 Heat Exchanger

An air fin heat exchanger, E-101, is installed on the discharge of the P-103 pump after the F-101 filters. The purpose of the air fin exchanger is to remove heat from the rotoformer feed stream. This heat removal results in improved operation of the rotoforming equipment.

4.2 ROTOFORMING

The Sandvik rotoforming equipment is expected to process 12.5 MTPH per machine. Each machine requires 68F cooling water at a rate of 228 usgpm and an assumed pressure of 30 psig. Cooling water will be returned at 85F, and must be drained to an underground vessel, because it will be discharged at atmospheric pressure.

Steam is used as a heating medium to ensure that flow can pass through the stator. Heating requirement ranges from 10,000 BTU/hr to 30,000 BTU/hr per machine. Condensate is returned to the plant condensate system.

Silicon solution is required at a rate of 2 L per MT of production, which equates to 1 usgpm of solution for 2700 MTPD. A water make-up line will be run into the rotoforming area.

4.3 UTILITIES

4.3.1 Cooling Water System

Cooling water is required at a rate of 228 usgpm per machine. For nine (9) machines, this equates to 2052 usgpm of cooling water and 1453 tons of refrigeration. Cooling water is supplied to the rotoforming unit from P-104, which takes suction from the above-ground cooling tower sump. The P-104 pump has discharge pressure sufficient to deliver cooling water to the rotoformer at 30 psig. The cooling tower sump will be equipped with an electrical heater for freeze protection.

Within the rotoforming facility, cooling water is drained to an underground concrete sump, T-108, at approximately 85F. The sump is designed for 10 minutes of residence time, or approximately 20,000 gallons. The approximate dimensions are 6.5 m long by 4 m wide by 3 m deep. From the sump, the cooling water is pumped with P-105 to the cooling tower, CT-101, where it is cooled to 68F. The P-105 submersible pump has discharge pressure sufficient to provide water to the top of the cooling tower at approximately 5 psig. The cooling tower design load is 1453 tons of refrigeration.

Cooling water losses are expected to be approximately 2 usgpm, from cooling tower evaporation and rotoforming losses.

Upstream of the cooling tower, a cooling tower blowdown connection is available to allow water to be purged from the system. The blowdown system is designed for the purging of 1% of the circulation rate, or 21 usgpm.

Make-up water, required at a rate of 23 usgpm, is treated to remove particulates and chlorides. A chemical injection facility allows for the introduction of water treatment chemicals that are used to minimize scaling and biological growth.

4.3.2 Steam / Condensate System

Alberta Sulphur Terminals has specified use of a 150 Hp boiler (5 mmBTU/hr fired duty) to generate steam that will be used in line jacketing and sulphur heating. Steam generation will normally be at 50 psig, but the boiler shall have the capability to produce up to 100 psig steam. It has been assumed that the boiler efficiency is 84%.

Natural gas requirements are approximately 5300 SCFH.

Normal process loads are relatively small, with an approximate heat load of 0.01 to 0.03 mmBTU/hr for each rotoformer and 0.25 mmBTU/hr for each of the sulphur tanks. The total continuous winter duty is expected to be between 2 and 3 mmBTU/hr, including the jacketed lines.

Condensate will be collected in C-101 and pumped back to the boiler using P-107. The condensate drum will be sized for at least 10 minutes of residence time (90 gallons). The approximate dimensions are 2 ft diameter by 6 ft height.

At boiler capacity, total steam production is 4450 lb/hr. Once through water requirements are approximately 9 usgpm. Assuming that steam losses are 20% and boiler blowdown is 3%, the make-up water requirement is approximately 2 usgpm.

Blowdown, at maximum 400 gallons per day is collected is a small tank, T-109, and periodically trucked off-site for disposal. This rate conservatively assumes zero flashing of the blowdown. The tank is sized for 2 vacuum trucks or 6,000 gallons total. The approximate dimensions are 9 ft (2.74 m) diameter by 14 ft (4.27 m) height.

Make-up water will be treated to remove hardness and a chemical injection facility will be used to add phosphate and amine solution.

Outdoor condensate lines will be electrically traced for freeze protection.

The boiler and condensate system will be located inside the main process building.

4.3.3 Make-up Water System

Make-up water is required for cooling water, boiler feed water, silicon solution, and unit train loading dust suppression. The make-up water requirements are estimated as:

- 23 usgpm to the cooling water system (of which 2 usgpm are system losses)
- 2 usgpm to the steam system
- 1 usgpm to the rotoformers for silicon solution generation

- 13 usgpm to railcar loading for dust suppression (based on 2 L / MT and loading 12,000 MT in an 8 hour period or 1 usgpm time averaged)

Total make-up water is approximately 26 usgpm, and is supplied from the S-101 run-off pond using P-108. Water treatment facility shall include filtration for the full stream, hardness removal for the boiler make-up, and chloride removal for the cooling water make-up.

Above ground outdoor sections of the make-up water system will be electrically traced.

4.3.4 Site Water System

Site water including precipitation run-off and cooling tower blowdown is collected is run-off pond S-101. A well is available to make-up water into the pond. Assuming that precipitation and evaporation are balanced, well water requirements will be approximately 6 usgpm. Above ground sections of the site water system will be electrically traced.

4.3.5 Firewater System

Firewater will be supplied to the rotoformer building sprinklers and to the two on-site monitors from S-101 using P-106. Above ground outdoor sections of the firewater system will be electrically traced.

4.3.6 Instrument Air System

An instrument air system will be installed for control valves and rotoformer pneumatics. The system will be complete with compressor, air receiver tank, and dryers. The system will be located inside the main process building and will be specified with 100 psig discharge pressure.

5.0 LINE SIZING

For this exercise, line sizing is based simply upon velocity criteria. For liquid lines:

Line Size	Limiting Velocity (ft/s)		
	Normal Lines	Pump Suction	Water Lines
1 ½	3.5-5.5	n/a	4
2	4-7	2	5
3	5-8	2.5	5
4	6-10	3	6
6	8-12	4-5	8
8	8-12	5	8
10 & Larger	10-12	6-7	9

For steam lines, velocity should be maintained below 200 ft/s in mains and 150 ft/s in branches. For high pressure natural gas, velocity should be maintained between 20 ft/s and 60 ft/s. For instrument air lines, velocity should be maintained between 30 ft/s and 100 ft/s.

5.1 Liquid Sulphur Lines

For pump discharge lines, line sizes of 3", 4", and 6" will support flowrates of 1700 MTPD, 3800 MTPD, and 10300 MTPD respectively. For pump suction lines, line sizes of 4", 6", and 8" will support flowrates of 1100 MTPD, 4300 MTPD, and 7600 MTPD respectively.

The following line sizes are recommended:

Line	Size	Comment
Truck Load-out	8"	Gravity drain
P-101 Discharge to T-101 thru T-106	6x8	
P-102 Suction from T-101 thru T-106	6x8	
P-102 Discharge to T-107	4x6	
P-103 Suction from T-107	8x10	Require 6x8 for 9 machines
P-103 Discharge to Rotoform Header	6x8	
Rotoform Header Recycle	6x8	Size for full flow from P-103
Header to Machine	2x3	1 ½" is borderline

5.2 Cooling Water Lines

A 10" line is required to handle 2052 usgpm of cooling water, which is consistent with 9 Sandvik machines. The expansion to 12 machines will require a 12" line.

For each machine, four (4) – 2" connections are required. From the main header to each machine, a 4" branch connection is required for 228 usgpm.

The cooling water return lines are gravity fed to T-108. Sandvik recommends four (4) – 4" connections from each machine. Each machine will require a single 8" drain line. If we assume that T-108 is centered between the 6th and 7th machine, it is recommended that a 20" header be installed for collection of the cooling water from each set of 6 machines. It is recommended that the underground piping be completed for the addition of the 3 machines at initial construction. An alternative solution is to provide trenches on the floor of the rotoforming building that feed cooling water to the sump.

5.3 Make-up Water Lines

To transfer 60 usgpm of make-up water from P-108 to the process building a 3" line is required.

5.4 Steam Lines

The main header from the boiler shall be sized as 4" to minimize pressure drop. The header to the tankage area shall be 3" and the Sandvik header shall be 2".

5.5 Condensate Lines

Condensate headers shall be sized as 2"

5.6 Natural Gas Line

The natural gas line shall be sized to 2". At 150 psig pressure, a 2" line has capacity for at least four (4) - 150 Hp boilers.

Attachment 2 : Lamont County Water Utility

ATTACHMENT #2
SIR 6

Lamont County

Agricultural Service Board
Public Works

ADMINISTRATION BLDG.
5303 - 50th Avenue
Lamont, Alberta T0B 2R0

Tel: (780) 895-2547
Fax: (780) 895-2892
Toll Free: (866) 895-2547
e-mail: info@tclamont.ca
website: www.countylamont.ab.ca

February 14, 2008

Hazco Environmental Services Ltd.
5125 – 50 Avenue
Lamont, Alberta T0B 2R0

Attn: Ms Sylvia Holowach;

Dear Madam;

Re: Water supply to Hazco Environmental

Recently you asked me about the ability for Hazco to connect to the existing water supply from Lamont County to supply the development of Hazco.

I would like to inform you that with great confidence that Hazco would indeed be able to connect to the Lamont County waterline in order to have a clean, potable water supply. Further, under normal operation, Hazco will have access to more than enough water to satisfy their daily needs of 46 liter's per minute.

For security of water supply and for ensuring your insurance requirements are satisfied, it is recommended that Hazco build an on site reservoir incase the supply of water should become temporarily interrupted and Lamont County be unable to supply water for a short period of time.

Providing Hazco is willing to meet the Lamont County GMSS (General Municipal Servicing Standards) for connecting to the Lamont County Water Utility, I for see no problems or issues with Hazco connecting to the system.

Sincerely,

Wayne Leontowich
Director of Public Works

WL/ks

Attachment 3 : Borehole Logs

Project Name: Limited Soil Investigation
Client: CCS Energy Services
Location: 35-55-20 W4M
Drilled by: Clay Drilling Inc.
Drill Date: Dec. 21/05
Compiled by: C. Fedor

Northing:
Easting:
Elevation:

KOMEX INTERNATIONAL LTD.
ENVIRONMENT AND WATER RESOURCES

Borehole # 05-13

PROJECT # C62720000

Depth (m)	Symbol	Description	Sample Depth (m)	Sample Type	VOC ▿ % LEL ▿ (0 25 50 75 100) • ppm • (0 100 300 500)	Well Data	Well Details
0		Ground Surface					
		TOPSOIL (0.0-0.3 m) Trace roots; frozen; dark grey.	0.0-0.3				Completed as a borehole, no well details.
		SILTY CLAY (0.3-3.0 m) Soft; moist; grey.	0.3-0.6				Surface Cuttings (0.00-0.30 m)
			0.6-1.0				
1							102 mm diameter borehole
		At 1.3 m: Firm; trace coarse fragments; dark yellowish to brown.					
			1.5				Backfilled with Bentonite Chips (0.30-3.00 m)
2			2.0				
			2.5				
		At 2.7 m: Fine-grained sand lenses.					
			3.0				
3		End of Borehole					TD of Borehole 3.00 m
4							
5							

Project Name: Limited Soil Investigation
Client: CCS Energy Services
Location: 35-55-20 W4M
Drilled by: Clay Drilling Inc.
Drill Date: Dec. 21/05
Compiled by: C. Fedor

Northing:
Easting:
Elevation:

KOMEX INTERNATIONAL LTD.
ENVIRONMENT AND WATER RESOURCES

Borehole # 05-14

PROJECT # C62720000

SUBSURFACE PROFILE

Depth (m)	Symbol	Description	Sample Depth (m)	Sample Type	VOC ▿ % LEL ▿ 0 25 50 75 100 / • ppm • 0 100 300 500	Well Data	Well Details
0		Ground Surface					
		TOPSOIL (0.0-0.2 m) Frozen; black.	0.0-0.3				Completed as a borehole, no well details.
		SILTY CLAY (0.2-1.2 m) Firm; trace fine-grained sand; moist; brown yellow.	0.3-0.6				Surface Cuttings (0.00-0.30 m)
		At 0.6-1.2 m: Firm; trace carbonates; trace fine-grained sand; moist; brown yellow.	0.6-1.0				
1							102 mm diameter borehole
		CLAY (1.2-3.0 m) Firm; trace coarse fragments; moist; dark yellow brown.					Backfilled with Bentonite Chips (0.30-3.00 m)
			1.5				
2		At 2.0-3.0 m: Olive grey streaking with trace fine-grained sand lenses.	2.0				
			2.5				
			3.0				
3		End of Borehole					TD of Borehole 3.00 m
4							
5							

Project Name: Limited Soil Investigation
Client: CCS Energy Services
Location: 35-55-20 W4M
Drilled by: Clay Drilling Inc.
Drill Date: Dec. 21/05
Compiled by: C. Fedor

Northing:
Easting:
Elevation:

KOMEX INTERNATIONAL LTD.
ENVIRONMENT AND WATER RESOURCES

Borehole # 05-15

PROJECT # C62720000

Depth (m)	Symbol	Description	Sample Depth (m)	Sample Type	VOC ▿ % LEL ▿ (0 25 50 75 100) • ppm • (0 100 300 500)	Well Data	Well Details
0		Ground Surface					
		TOPSOIL (0.0-0.3 m) Friable; trace roots; dry; dark grey.	0.0-0.3				Completed as a borehole, no well details.
		SILTY CLAY (0.3-3.0 m) Friable; dry; brown yellow.	0.3-0.6				Surface Cuttings (0.00-0.30 m)
		At 0.6-1.0 m: Firm; trace carbonates; moist; brown yellow.	0.6-1.0				
1		At 1.0-2.0 m: Firm; trace coarse fragments; moist; dark yellow brown.					102 mm diameter borehole
			1.5				Backfilled with Bentonite Chips (0.30-3.00 m)
2		At 2.0 m: Grey streaking; trace fine-grained sand lenses.	2.0				
			2.5				
			3.0				
3		End of Borehole					TD of Borehole 3.00 m
4							
5							

Project Name: Limited Soil Investigation
Client: CCS Energy Services
Location: 35-55-20 W4M
Drilled by: Clay Drilling Inc.
Drill Date: Dec. 21/05
Compiled by: C. Fedor

Northing:
Easting:
Elevation:

KOMEX INTERNATIONAL LTD.
ENVIRONMENT AND WATER RESOURCES

Borehole # 05-16

PROJECT # C62720000

SUBSURFACE PROFILE

Depth (m)	Symbol	Description	Sample Depth (m)	Sample Type	VOC ▿ % LEL ▿ 0 25 50 75 100 / • ppm • 0 100 300 500	Well Data	Well Details
0		Ground Surface					
		TOPSOIL (0.0-0.3 m) Trace roots; frozen; dark grey.	0.0-0.3				Completed as a borehole, no well details.
		SILTY CLAY (0.3-0.8 m) Firm; trace sand; moist; yellow brown.	0.3-0.6				Surface Cuttings (0.00-0.30 m)
			0.6-1.0				
1		***CLAY (0.8-2.9 m)*** Firm; trace coarse fragments; moist; yellow brown.					102 mm diameter borehole
		At 1.5 m: Trace wet fine-grain sand stringers.	1.5				Backfilled with Bentonite Chips
		At 1.5-3.0 m: Firm; moist; dark yellow brown.					(0.30-3.00 m)
2		At 2.0 m: Grey streaking.	2.0				
			2.5				
			3.0				
3		***SILTSTONE BEDROCK (2.9-3.0 m)*** Stiff; dry; grey.					TD of Borehole 3.00 m
		End of Borehole					
4							
5							

Project Name: Limited Soil Investigation
Client: CCS Energy Services
Location: 35-55-20 W4M
Drilled by: Clay Drilling Inc.
Drill Date: Dec. 21/05
Compiled by: C. Fedor

Northing:
Easting:
Elevation:

KOMEX INTERNATIONAL LTD.
ENVIRONMENT AND WATER RESOURCES

Borehole # 05-17

PROJECT # C62720000

SUBSURFACE PROFILE

Depth (m)	Symbol	Description	Sample Depth (m)	Sample Type	VOC ▿ % LEL ▿ 0 25 50 75 100 / • ppm • 0 100 300 500	Well Data	Well Details
0		Ground Surface					
		TOPSOIL (0.0-0.3 m) Trace carbonates; frozen; yellow brown.	0.0-0.3				Completed as a borehole, no well details.
		SILTY CLAY (0.3-0.6 m) Firm; increased sand content; trace carbonates; moist; yellow brown.	0.3-0.6				Surface Cuttings (0.00-0.30 m)
		CLAY (0.6-2.8 m) Firm; trace subrounded gravel; moist; dark yellow brown.	0.6-1.0				
1		At 1.2-2.5 m: Firm; trace coarse fragments; moist; yellow brown.					102 mm diameter borehole
			1.5				Backfilled with Bentonite Chips (0.30-3.00 m)
2			2.0				
		At 2.5-2.8 m: Firm; trace coarse fragments; moist; yellow brown.	2.5				
		SILTSTONE BEDROCK (2.8-3.0 m) Firm; moist; grey.	3.0				
3		End of Borehole					TD of Borehole 3.00 m
4							
5							

Project Name: Limited Soil Investigation
Client: CCS Energy Services
Location: 35-55-20 W4M
Drilled by: Clay Drilling Inc.
Drill Date: Dec. 21/05
Compiled by: C. Fedor

Northing:
Easting:
Elevation:

KOMEX INTERNATIONAL LTD.
ENVIRONMENT AND WATER RESOURCES

Borehole # 05-18

PROJECT # C62720000

SUBSURFACE PROFILE

Depth (m)	Symbol	Description	Sample Depth (m)	Sample Type	VOC ▿ % LEL ▿ 0 25 50 75 100 / • ppm • 0 100 300 500	Well Data	Well Details
0		Ground Surface					
		TOPSOIL (0.0-0.1 m) Frozen; dark grey.	0.0-0.3				Completed as a borehole, no well details.
		SILTY CLAY (0.1-1.0 m) Stiff; some carbonates; moist; yellow brown.	0.3-0.6				Surface Cuttings (0.00-0.30 m)
			0.6-1.0				
1		***CLAY (1.0-1.5 m)*** Firm; trace coarse fragments; moist; yellow brown.					102 mm diameter borehole
		CLAY TILL (1.5-3.0 m) Firm; trace subangular gravel; trace sand; trace coal flecks; moist; dark brown.	1.5				Backfilled with Bentonite Chips (0.30-3.00 m)
2			2.0				
			2.5				
			3.0				
3		End of Borehole					TD of Borehole 3.00 m
4							
5							

Project Name: Limited Soil Investigation
Client: CCS Energy Services
Location: 35-55-20 W4M
Drilled by: Clay Drilling Inc.
Drill Date: Dec. 21/05
Compiled by: C. Fedor

Northing:
Easting:
Elevation:

KOMEX INTERNATIONAL LTD.
ENVIRONMENT AND WATER RESOURCES

Borehole # 05-19

PROJECT # C62720000

SUBSURFACE PROFILE

Depth (m)	Symbol	Description	Sample Depth (m)	Sample Type	VOC ▿ % LEL ▿ 0 25 50 75 100 / • ppm • 0 100 300 500	Well Data	Well Details
0		Ground Surface					
		SILTY CLAY (0.0-1.2 m) Frozen; yellow brown.	0.0-0.3				Completed as a borehole, no well details.
		At 0.3-1.2 m: Stiff; carbonates; dry; yellow brown.	0.3-0.6				Surface Cuttings (0.00-0.30 m)
			0.6-1.0				
1							102 mm diameter borehole
		CLAY TILL (1.2-3.0 m) Firm; moist; dark yellow brown.					
			1.5				Backfilled with Bentonite Chips (0.30-3.00 m)
2			2.0				
		At 2.5 m: Trace coal.	2.5				
			3.0				
3		End of Borehole					TD of Borehole 3.00 m
4							
5							

Project Name: Limited Soil Investigation
Client: CCS Energy Services
Location: 35-55-20 W4M
Drilled by: Clay Drilling Inc.
Drill Date: Dec. 21/05
Compiled by: C. Fedor

Northing:
Easting:
Elevation:

KOMEX INTERNATIONAL LTD.
ENVIRONMENT AND WATER RESOURCES

Borehole # 05-20

PROJECT # C62720000

SUBSURFACE PROFILE

Depth (m)	Symbol	Description	Sample Depth (m)	Sample Type	VOC ▿ % LEL ▿ 0 25 50 75 100 / • ppm • 0 100 300 500	Well Data	Well Details
		Ground Surface					Stick-Up 0.90 m
0		***SILTY CLAY (0.0-0.6 m)*** Some carbonates; frozen; yellow brown.	0.0-0.3				
			0.3-0.6				Sil 9 Sand (0.00-0.30 m)
		CLAY TILL (0.6-4.9 m) Firm; trace coarse fragments; trace sand; moist; dark yellow brown.	0.6-1.0				Hydrated Bentonite Pellets (0.30-1.61 m)
1							51 mm ID Sch 40 PVC pipe
		At 1.5-2.5 m: Yellow brown.	1.5				Top of Sand at 1.61m Sil 9 Sand
							Top of Screen at 1.95 m
2			2.0				
		At 2.5-3.2 m: Firm; trace coarse fragments; abundant mottles; moist; dark brown.	2.5				3.05 x 51 mm ID Sch 40 PVC 020 Slot Screen
3			3.0				Solid Stem Borehole (152 mm diameter)
		At 3.2-5.0 m: Trace coarse fragments; trace gravels; moist; trace fine-grained sand lenses; moist; dark yellow brown.					
4			4.0				Botton of Screen at 5.00 m
		SILTSTONE BEDROCK (4.9-5.0 m) Moist; grey.	5.0				TD of Borehole 5.00 m
5		End of Borehole					

Project Name: Limited Soil Investigation
Client: CCS Energy Services
Location: 35-55-20 W4M
Drilled by: Clay Drilling Inc.
Drill Date: Dec. 21/05
Compiled by: C. Fedor

Northing:
Easting:
Elevation:

KOMEX INTERNATIONAL LTD.
ENVIRONMENT AND WATER RESOURCES

Borehole # 05-21

PROJECT # C62720000

SUBSURFACE PROFILE

Depth (m)	Symbol	Description	Sample Depth (m)	Sample Type	VOC ▿ % LEL ▿ 0 25 50 75 100 / • ppm • 0 100 300 500	Well Data	Well Details
0		Ground Surface					
		SILTY CLAY (0.0-1.5 m) Friable; dry; yellow brown.	0.0-0.3				Completed as a borehole, no well details.
		At 0.4-1.5 m: Some carbonates.	0.3-0.6				Surface Cuttings (0.00-0.30 m)
			0.6-1.0				
1							102 mm diameter borehole
		CLAY TILL (1.5-3.0 m) Firm; trace carbonates; trace sand; trace coarse fragments; moist; dark yellow brown.	1.5				Backfilled with Bentonite Chips (0.30-3.00 m)
2			2.0				
			2.5				
			3.0				
3		End of Borehole					TD of Borehole 3.00 m
4							
5							

Project Name: Limited Soil Investigation
Client: CCS Energy Services
Location: 35-55-20 W4M
Drilled by: Clay Drilling Inc.
Drill Date: Dec. 21/05
Compiled by: C. Fedor

Northing:
Easting:
Elevation:

KOMEX INTERNATIONAL LTD.
ENVIRONMENT AND WATER RESOURCES

Borehole # 05-22

PROJECT # C62720000

SUBSURFACE PROFILE

Depth (m)	Symbol	Description	Sample Depth (m)	Sample Type	VOC ▿ % LEL ▿ 0 25 50 75 100 / ● ppm ● 0 100 300 500	Well Data	Well Details
0		Ground Surface					
		SILTY CLAY (0.0-0.8 m) Loose; friable; dry; yellow brown.	0.0-0.3				Completed as a borehole, no well details.
			0.3-0.6				Surface Cuttings (0.00-0.30 m)
		At 0.6 m: Trace carbonates.	0.6-1.0				
1		***CLAY TILL (0.8-3.0 m)*** Firm; trace sand; trace coal; trace coarse fragments; moist; yellow brown.					102 mm diameter borehole
			1.5				Backfilled with Bentonite Chips (0.30-3.00 m)
2			2.0				
			2.5				
			3.0				
3		End of Borehole					TD of Borehole 3.00 m
4							
5							

Project Name: Limited Soil Investigation
Client: CCS Energy Services
Location: 35-55-20 W4M
Drilled by: Clay Drilling Inc.
Drill Date: Dec. 21/05
Compiled by: C. Fedor

Northing:
Easting:
Elevation:

KOMEX INTERNATIONAL LTD.
ENVIRONMENT AND WATER RESOURCES

Borehole # 05-23

PROJECT # C62720000

SUBSURFACE PROFILE

Depth (m)	Symbol	Description	Sample Depth (m)	Sample Type	VOC ▿ % LEL ▿ 0 25 50 75 100 / ● ppm ● 0 100 300 500	Well Data	Well Details
0		Ground Surface					
		SILTY CLAY (0.0-0.6 m) Loose; dry; yellow brown.	0.0-0.3				Completed as a borehole, no well details.
			0.3-0.6				Surface Cuttings (0.00-0.30 m)
		SILTY CLAY (0.6-1.5 m) Firm; trace carbonates; trace coarse fragments; moist; yellow brown.	0.6-1.0				
1							102 mm diameter borehole
		CLAY TILL (1.5-3.0 m) Firm; trace sand; trace coal; trace coarse fragments; moist; yellow brown.	1.5				Backfilled with Bentonite Chips (0.30-3.00 m)
2			2.0				
			2.5				
			3.0				
3		End of Borehole					TD of Borehole 3.00 m
4							
5							

Project Name: Limited Soil Investigation
Client: CCS Energy Services
Location: 35-55-20 W4M
Drilled by: Clay Drilling Inc.
Drill Date: Dec. 21/05
Compiled by: C. Fedor

Northing:
Easting:
Elevation:

KOMEX INTERNATIONAL LTD.
ENVIRONMENT AND WATER RESOURCES

Borehole # 05-24

PROJECT # C62720000

Depth (m)	Symbol	Description	Sample Depth (m)	Sample Type	VOC ▿ % LEL ▿ (0 25 50 75 100) • ppm • (0 100 300 500)	Well Data	Well Details
0		Ground Surface					
		SILTY CLAY (0.0-1.2 m) Soft; moist; yellow brown.	0.0-0.3				Completed as a borehole, no well details.
		At 0.3-1.2 m: Firm; moist; yellow brown.	0.3-0.6				Surface Cuttings (0.00-0.30 m)
			0.6-1.0				
1							102 mm diameter borehole
		SAND (1.2-1.5 m) Medium-grained; yellow brown.					
		CLAY (1.5-3.0 m) Firm; trace coarse fragments; moist; dark yellow brown.	1.5				Backfilled with Bentonite Chips (0.30-3.00 m)
2			2.0				
		At 2.5-3.0 m: Stiff; trace mottles; moist; yellow brown.	2.5				
			3.0				
3		End of Borehole					TD of Borehole 3.00 m
4							
5							

Project Name: Limited Soil Investigation
Client: CCS Energy Services
Location: 35-55-20 W4M
Drilled by: Clay Drilling Inc.
Drill Date: Dec. 21/05
Compiled by: C. Fedor

Northing:
Easting:
Elevation:

KOMEX INTERNATIONAL LTD.
ENVIRONMENT AND WATER RESOURCES

Borehole # 05-25

PROJECT # C62720000

Depth (m)	Symbol	Description	Sample Depth (m)	Sample Type	VOC ▿ % LEL ▿ (0 25 50 75 100) • ppm • (0 100 300 500)	Well Data	Well Details
0		Ground Surface					
		SAND (0.0-1.5 m) Loose; fine-grained; moist.	0.0-0.3				Completed as a borehole, no well details.
			0.3-0.6				Surface Cuttings (0.00-0.30 m)
		At 0.6-1.5 m: Moist; dark brown.	0.6-1.0				
1							102 mm diameter borehole
		CLAY TILL (1.5-3.0 m) Firm; trace coarse fragments; moist; yellow brown.	1.5				Backfilled with Bentonite Chips (0.30-3.00 m)
2			2.0				
			2.5				
			3.0				
3		End of Borehole					TD of Borehole 3.00 m
4							
5							

Project Name: Limited Soil Investigation
Client: CCS Energy Services
Location: 35-55-20 W4M
Drilled by: Clay Drilling Inc.
Drill Date: Dec. 21/05
Compiled by: C. Fedor

Northing:
Easting:
Elevation:

KOMEX INTERNATIONAL LTD.
ENVIRONMENT AND WATER RESOURCES

Borehole # 05-26

PROJECT # C62720000

Depth (m)	Symbol	Description	Sample Depth (m)	Sample Type	VOC ▿ % LEL ▿ 0 25 50 75 100 • ppm • 0 100 300 500	Well Data	Well Details
0		Ground Surface					
		TOPSOIL (0.0-0.3 m) Trace roots; frozen; black.	0.0-0.3				Completed as a borehole, no well details.
		SAND (0.3-0.6 m) Loose; fine-grained; moist.	0.3-0.6				Surface Cuttings (0.00-0.30 m)
		CLAY 0.6-1.5 m) Firm; trace coarse fragments; moist; yellow brown.	0.6-1.0				
1							102 mm diameter borehole
		CLAY TILL (1.5-2.5 m) Moist; dark yellow brown.	1.5				Backfilled with Bentonite Chips (0.30-3.00 m)
2			2.0				
		SAND (2.5-2.8 m) Fine-grained; dense; moist; yellow brown.	2.5				
		GRAVEL (2.8-3.0 m) Loose; wet; yellow brown.	3.0				
3		End of Borehole					TD of Borehole 3.00 m
4							
5							

Project Name: Limited Soil Investigation
Client: CCS Energy Services
Location: 35-55-20 W4M
Drilled by: Clay Drilling Inc.
Drill Date: Dec. 21/05
Compiled by: C. Fedor

Northing:
Easting:
Elevation:

KOMEX INTERNATIONAL LTD.
ENVIRONMENT AND WATER RESOURCES

Borehole # 05-27

PROJECT # C62720000

Depth (m)	Symbol	Description	Sample Depth (m)	Sample Type	VOC (% LEL: 0 25 50 75 100; ppm: 0 100 300 500)	Well Data	Well Details
0		Ground Surface					
		TOPSOIL (0.0-0.3 m) Trace roots; frozen; black.	0.0-0.3				Completed as a borehole, no well details.
		SILTY CLAY (0.3-1.2 m) Firm; moist; yellow brown.	0.3-0.6				Surface Cuttings (0.00-0.30 m)
		At 0.6-1.2 m: Firm; trace sand; trace carbonates; moist; yellow brown.	0.6-1.0				
1							102 mm diameter borehole
		GRAVEL (1.2-1.5 m)					
		CLAY (1.5-3.0 m) Firm; moist; pale yellow brown.	1.5				Backfilled with Bentonite Chips (0.30-3.00 m)
2			2.0				
		At 2.5-3.0 m: Firm; moist; yellow brown.	2.5				
			3.0				
3		End of Borehole					TD of Borehole 3.00 m
4							
5							

Project Name: Limited Soil Investigation
Client: CCS Energy Services
Location: 35-55-20 W4M
Drilled by: Clay Drilling Inc.
Drill Date: Dec. 21/05
Compiled by: C. Fedor

Northing:
Easting:
Elevation:

KOMEX INTERNATIONAL LTD.
ENVIRONMENT AND WATER RESOURCES

Borehole # 05-28

PROJECT # C62720000

SUBSURFACE PROFILE

Depth (m)	Symbol	Description	Sample Depth (m)	Sample Type	VOC ▿ % LEL ▿ 0 25 50 75 100 / • ppm • 0 100 300 500	Well Data	Well Details
-1							Stick-Up 1.00 m
0		Ground Surface					
		TOPSOIL (0.0-0.3 m) Soft; moist; black.	0.0-0.3				Sil 9 (0.00-0.15 m)
		SANDY SILT (0.3-0.6 m) Soft; moist; grey.	0.3-0.6				Hydrated Bentonite Chips (0.15-0.75 m)
		CLAY (0.6-1.8 m) Soft; trace coarse fragments; moist; yellow brown.	0.6-1.0				Top of Sand at 0.75 m Sil 9 Sand
1							Top of Screen at 1.10 m
							3.05 x 51 mm ID Sch 40 PVC 020 Slot Screen
			1.5				
		CLAY TILL (1.8-3.0 m) Firm; trace sand; trace coarse fragments; moist; yellow brown.					Solid Stem Borehole (152 mm diameter)
2			2.0				
			2.5				
3		***SAND (3.0-4.5 m)*** Fine-grained; dense; wet; grey.	3.0				51 mm Sch 40 PVC pipe
			4.0				Bottom of Screen at 4.15 m
4							Slough (4.15-4.50 m)
		End of Borehole					TD of Borehole 4.50 m
5							

Project Name: Limited Soil Investigation
Client: CCS Energy Services
Location: 35-55-20 W4M
Drilled by: Clay Drilling Inc.
Drill Date: Dec. 21/05
Compiled by: C. Fedor

Northing:
Easting:
Elevation:

KOMEX INTERNATIONAL LTD.
ENVIRONMENT AND WATER RESOURCES

Borehole # 05-29

PROJECT # C62720000

SUBSURFACE PROFILE

Depth (m)	Symbol	Description	Sample Depth (m)	Sample Type	VOC ▿ % LEL ▿ 0 25 50 75 100 / • ppm • 0 100 300 500	Well Data	Well Details
0		Ground Surface					
		SILTY CLAY (0.0-0.6 m) Frozen; yellow brown.	0.0-0.3				Completed as a borehole, no well details.
		At 0.3-0.6 m: Loose; trace carbonates; dry; yellow brown.	0.3-0.6				Surface Cuttings (0.00-0.30 m)
		CLAY TILL (0.6-3.0 m) Firm trace sand; trace coarse fragments; trace coal; trace sub-rounded gravel; moist; yellow brown.	0.6-1.0				
1							102 mm diameter borehole
			1.5				Backfilled with Bentonite Chips (0.30-3.00 m)
2			2.0				
			2.5				
			3.0				
3		End of Borehole					TD of Borehole 3.00 m
4							
5							

Project Name: Limited Soil Investigation
Client: CCS Energy Services
Location: 35-55-20 W4M
Drilled by: Clay Drilling Inc.
Drill Date: Dec. 21/05
Compiled by: C. Fedor

Northing:
Easting:
Elevation:

KOMEX INTERNATIONAL LTD.
ENVIRONMENT AND WATER RESOURCES

Borehole # 05-30

PROJECT # C62720000

SUBSURFACE PROFILE

Depth (m)	Symbol	Description	Sample Depth (m)	Sample Type	VOC ▿ % LEL ▿ 0 25 50 75 100 / • ppm • 0 100 300 500	Well Data	Well Details
0		Ground Surface					
		TOPSOIL (0.0-0.3 m) Frozen; black.	0.0-0.3				Completed as a borehole, no well details.
		SILTY CLAY (0.3-0.6 m) Loose; trace carbonates; dry; yellow brown.	0.3-0.6				Surface Cuttings (0.00-0.30 m)
		CLAY TILL (0.6-2.5 m) Firm; trace sand; trace coarse fragments; trace gravel; moist; yellow brown.	0.6-1.0				
1							102 mm diameter borehole
			1.5				Backfilled with Bentonite Chips (0.30-3.00 m)
2			2.0				
		SILTSTONE BEDROCK (2.5-3.0 m) Weathered; stiff; moist.	2.5				
			3.0				
3		End of Borehole					TD of Borehole 3.00 m
4							
5							

Project Name: Limited Soil Investigation
Client: CCS Energy Services
Location: 35-55-20 W4M
Drilled by: Clay Drilling Inc.
Drill Date: Dec. 21/05
Compiled by: C. Fedor

Northing:
Easting:
Elevation:

KOMEX INTERNATIONAL LTD.
ENVIRONMENT AND WATER RESOURCES

Borehole # 05-31

PROJECT # C62720000

Depth (m)	Symbol	Description	Sample Depth (m)	Sample Type	VOC ▿ % LEL ▿ (0 25 50 75 100) • ppm • (0 100 300 500)	Well Data	Well Details
0		Ground Surface					Completed as a borehole, no well details.
		TOPSOIL (0.0-0.3 m) Frozen; black.	0.0-0.3				Surface Cuttings (0.00-0.30 m)
		SILTY CLAY (0.3-1.0 m) Friable; dry; yellow brown.	0.3-0.6				
		At 0.6-1.0 m: Firm; trace carbonates; moist; yellow brown.	0.6-1.0				
1		***CLAY TILL (1.0-1.8 m)*** Firm; trace sand; trace coarse fragments; moist; yellow brown.					102 mm diameter borehole
			1.5				Backfilled with Bentonite Chips (0.30-3.00 m)
2		***SAND (1.8-3.0 m)*** Very fine-grained; dense; moist; yellow brown.	2.0				
			2.5				
			3.0				
3		End of Borehole					TD of Borehole 3.00 m
4							
5							

Project Name: Limited Soil Investigation
Client: CCS Energy Services
Location: 35-55-20 W4M
Drilled by: Clay Drilling Inc.
Drill Date: Dec. 21/05
Compiled by: C. Fedor

Northing:
Easting:
Elevation:

KOMEX INTERNATIONAL LTD.
ENVIRONMENT AND WATER RESOURCES

Borehole # 05-32

PROJECT # C62720000

SUBSURFACE PROFILE

Depth (m)	Symbol	Description	Sample Depth (m)	Sample Type	VOC ▿ % LEL ▿ 0 25 50 75 100 • ppm • 0 100 300 500	Well Data	Well Details
0		Ground Surface					
		TOPSOIL (0.0-0.3 m) Frozen; black.	0.0-0.3				Completed as a borehole, no well details.
		SILTY CLAY (0.3-0.8 m) Friable; dry; yellow brown.	0.3-0.6				Surface Cuttings (0.00-0.30 m)
			0.6-1.0				
		CLAY TILL (0.8-1.8 m) Firm; trace sand; trace coarse fragments; moist; yellow brown.					102 mm diameter borehole
1							Backfilled with Bentonite Chips (0.30-3.00 m)
			1.5				
		SANDY CLAY (1.8-2.8 m) Very fine-grained; dense; moist; yellow brown.					
2			2.0				
			2.5				
		SILTSTONE BEDROCK (2.8-3.0 m) Stiff; moist; grey.	3.0				TD of Borehole 3.00 m
3		End of Borehole					
4							
5							

Project Name: Limited Soil Investigation
Client: CCS Energy Services
Location: 35-55-20 W4M
Drilled by: Clay Drilling Inc.
Drill Date: Dec. 21/05
Compiled by: C. Fedor

Northing:
Easting:
Elevation:

KOMEX INTERNATIONAL LTD.
ENVIRONMENT AND WATER RESOURCES

Borehole # 05-33

PROJECT # C62720000

Depth (m)	Symbol	Description	Sample Depth (m)	Sample Type	VOC ▿ % LEL ▿ 0 25 50 75 100 / • ppm • 0 100 300 500	Well Data	Well Details
0		Ground Surface					
		TOPSOIL (0.0-0.3 m) Frozen; black.	0.0-0.3				Completed as a borehole, no well details.
		SILTY SAND (0.3-1.2 m) Loose; moist; yellow brown.	0.3-0.6				Surface Cuttings (0.00-0.30 m)
			0.6-1.0				
1							102 mm diameter borehole
		SILTSTONE BEDROCK (1.2-3.0 m) Weathered; stiff; moist; grey.					
			1.5				Backfilled with Bentonite Chips (0.30-3.00 m)
2			2.0				
		At 2.3-3.0 m: Stiff; moist; yellow brown.					
			2.5				
			3.0				
3		End of Borehole					TD of Borehole 3.00 m
4							
5							

Attachment 4 : Grain Size Analysis

DM LEAHEY & ASSOCIATES LTD.
3036 2 ST SW
CALGARY, AB
CANADA T2S 1T3

Attention: DOUGLAS M. LEAHEY

Report Date: 2005/08/03

Your C.O.C. #: 94605

ANALYTICAL REPORT

MAXXAM JOB #: A528813
Received: 2005/07/21, 22:30

Sample Matrix: Soil
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Particle Size by Sieve - Special (1)	1	2005/07/29	2005/07/29	CAL SOP# 0045	GRAVIMETRIC

(1) Result indicates % of sample retained on the sieve.

MAXXAM Analytics Inc.

AZMINA MERALI
Manager - Inorganics

AM/bo
encl.

Total cover pages: 1

Maxxam Analytics Inc

Maxxam Job #: A528813
Report Date: 2005/08/03

DM LEAHEY & ASSOCIATES LTD.
Client Project #:
Site Reference:
Sampler Initials:

RESULTS OF CHEMICAL ANALYSES OF SOIL

Maxxam ID		871595		
Sampling Date				
COC Number		94605		
	Units	**SOLID SAMPLE**	**DL**	**QC Batch**
Physical Properties				
Sieve - #10 (>2.00mm)	%	99.8	0.01	847349
Sieve - #18 (>1.00 mm)	%	0.03	0.01	847349
Sieve - #30 (>0.60mm)	%	<0.01	0.01	847349
Sieve #60 (>0.25 mm)	%	<0.01	0.01	847349
Sieve - #100(>0.15mm)	%	0.01	0.01	847349
Sieve - #200 (>0.075mm)	%	0.02	0.01	847349
Sieve - #325 (>0.045mm)	%	0.02	0.01	847349
Sieve - #400 (>0.030 mm)	%	0.03	0.01	847349
Sieve - #635 (>0.020mm)	%	0.02	0.01	847349
Sieve - Pan	%	0.96	0.01	847349

Maxxam Analytics Inc

Maxxam Job #: A528813
Report Date: 2005/08/03

DM LEAHEY & ASSOCIATES LTD.
Client Project #:
Site Reference:
Sampler Initials:

RESULTS OF CHEMICAL ANALYSES OF SOIL Comments

QC STANDARD Particle Size by Sieve - Special: Approved as per QA/QC

Results relate only to the items tested.

Maxxam Analytics Inc

DM LEAHEY & ASSOCIATES LTD.
Attention: DOUGLAS M. LEAHEY
Client Project #:
P.O. #:
Site Reference:

Quality Assurance Report

Maxxam Job Number: CA528813

QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
847349 SMA	QC STANDARD	Sieve - #200 (>0.075mm)	2005/08/03		142 (1)	%	92 - 108
	RPD	Sieve - #200 (>0.075mm)	2005/08/03	3.4		%	N/A
	QC STANDARD	Sieve - Pan	2005/08/03		81 (1)	%	85 - 115
	RPD	Sieve - Pan	2005/08/03	2.5		%	N/A

N/A = Not Applicable
RPD = Relative Percent Difference
(1) Please note that the recovery of some compounds are outside control limits however the overall quality control for this analysis meets our acceptability criteria.

Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone(403) 291-3077 FAX(403) 291-9468

Attachment 5: Shell Shantz Stack Survey 2003

COMPLIANCE SOURCE EMISSION SURVEY
SHELL CANADA LIMITED
SHANTZ SULPHUR HANDLING FACILITY

File # 03C055230

November 11,12 and 25, 2003

Prepared by:

Thomas E. Bourque, C. Tech.

AGAT Laboratories
Source Testing Services Group
3650 – 21st Street N.E.
Calgary, Alberta
T2E 6V6

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CANADA T2E 6V6

AGAT® Laboratories

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December 17, 2003

Shell Canada Limited
PO Box 500
Caroline, Alberta
T0M 0M0

Attention: **Mr. Brian Goliss**

Regarding: **Compliance Source Emission Testing at the Shantz Sulphur Handling Facility, Rotoformers D and E - AGAT File No. 03C055230**

AGAT Laboratories'-Source Testing Services Group is pleased to submit the following report for Compliance Source Emission Testing conducted at the Shell Canada Limited-Shantz Sulphur Handling Facility. Testing was performed on November 11,12 and 25, 2003.

Protocol for the testing are established by the Alberta Stack Sampling Code (ASSC REF 89) and by the Alberta Environmental Centre, Methods Manual for Chemical Analysis of Atmospheric Pollutants, 1993.

If you have any questions or concerns regarding this report, please contact Tom Bourque at (403) 299-2170, or by fax at (403) 299-2010, or via the Internet at **tbourque@agatlabs.com**. Alternatively, please contact Jeff Cooper at (403) 299-2183, or via the Internet at **cooper@agatlabs.com.** Thank you for your patronage, and we look forward to being of service to you in the future.

AGAT Laboratories

Thomas E. Bourque, C. Tech.
Manager
Source Testing Services

Reviewed By

Shawn MacGillivray, B.A.
Senior Technologist
Source Testing Services

SUMMARY

AGAT Laboratories'-Source Testing Services Group conducted a Compliance Source Emission Testing Program for Shell Canada Limited on November 11,12 and 25, 2003.Testing was performed on Rotoformers D and E at the Shantz Sulphur Handling Facility.

Table 1 presents a summary of results obtained from the testing with comparison to license limitations as provided by Alberta Environmental Protection.

Table 1: Summary of Test Results – Rotoformers D and E

Parameter	Units	Rotoformer "D" (Avg)	Rotoformer "E" (Avg)	License Limits
Particulate	**g/kg dry**	0.00767	0.00614	**0.05 g/kg as averaged from 3 one-hour tests**
	kg/hour	0.0692	0.0520	-
Hydrogen Sulphide	**ppm wet**	2.73	0.152	-
	kg/hour	0.0324	0.00167	-

*Minimum detection limits have been used for sample results that were below detection limits.

0.0192 g/s

=0.009 g/s

He applied more conservative 0.105 g/s

TABLE OF CONTENTS

LIST OF TABLES

PART 1 - INTRODUCTION

1.1 Background Information

AGAT Laboratories'-Source Emissions Testing Group was retained by Mrs. Diana Gilbert of Shell Canada Limited to conduct a Compliance Source Emission Testing Program on Rotoformers D and E at the Shantz Sulphur Handling Facility.

Parameters tested for were Particulate and Hydrogen Sulphide. Measurements for flue-gas moisture content, velocity and temperature were collected in order that Volumetric Flow rates and emission rates of the tested parameters could be determined. Testing was conducted on November 11,12 and 25, 2003.

1.2 Key Personnel

Mr. Brett Gole represented Shell Canada during the program. Shawn MacGillivray and Kent Mann conducted the sampling, while Tom Bourque performed the data reduction and produced the final report.

PART 2 - METHODS

Table 2 presents methods applicable to the testing performed.

Table 2: Standard Methods

PARAMETER	STANDARD METHOD
Total Particulate	Method 5 – Determination of Particulate Emissions from Stationary Sources; Alberta Stack Sampling Code (ASSC REF 89)
Hydrogen Sulphide	Method No. 43535 – Determination of Hydrogen Sulphide Methods Manual for Chemical Analysis of Atmospheric Pollutants ,1993
Velocity Traverses	Method 1 – Sample and Velocity Traverses for Stationary Sources; Alberta Stack Sampling Code (ASSC REF 89)
Volumetric Flow Rate	Method 2 – Determination of Stack Gas Velocity and Volumetric Flow Rate (Type s Pitot Tube); Alberta Stack Sampling Code (ASSC REF 89)
Fixed Gas Analysis (O_2,CO_2, N_2)	Method 3 – Gas Analysis for the Determination of Dry Molecular Weight; Alberta Stack Sampling Code (ASSC REF 89)
Stack Gas Moisture	Method 4 – Determination of Moisture Content in Stack Gases; Alberta Stack Sampling Code (ASSC REF 89)

2.1 Field Sampling and Analytical Methods

All equipment used for this work satisfies specifications required by Alberta Environmental Protection, Stack Sampling Code (ASSC REF 89).

Sampling, data collection and analytical procedures were conducted according to protocol established by the Alberta Environmental Protection Stack Sampling Code (ASSC REF 89) and by the Methods Manual for Chemical analysis of Atmospheric Pollutants. Methods specific to parameters measured are listed in Table 2.

2.2 Equipment Calibration

The dry gas meter and orifice, thermocouples and sample probe-pitot tube assemblies were calibrated according to the requirements of the Alberta Stack Sampling Code. The Pitot tube assembly was last calibrated in June 2003. The dry gas meters and orifice were last calibrated in January 2003. The thermocouples were last calibrated in August 2003. The digital temperature readouts was last calibrated in January and May of 2003. The nozzles were last calibrated in January 2003.

2.3 Quality Assurance / Quality Control

AGAT Laboratories is accredited by the Canadian Association of Environmental Analytical Laboratories (CAEAL) and the American Industrial Hygiene Association (AIHA). AGAT Laboratories Ltd. is also an ISO 9002 registered company. AGAT's source testing department QA/AC protocols include, but are not limited to the following:

- Regular maintenance and calibration of all field sampling equipment as per the applicable sampling protocols.
- Proper preparation of sampling glassware.
- On site leak checks, which include the dry gas meter, pump and sample train as well a flow measuring devices.
- Proper sealing, labeling, storing, transport and chain of custody procedures.
- Analysis of field blanks to determine possible background contamination.
- QA/QC on final report and all Lab analysis.

PART 3 – RESULTS

Table 3: Parameter Test Results – Rotoformer D

Parameter	One	Two	Three	Average	Units
Date	Nov. 11/03	Nov. 12/03	Nov. 12/03		
Times Start	15:05	10:40	12:31		
Final	16:08	11:42	13:37		
Gas Velocity	17.9	18.3	18.4	18.2	m/s
Flow Rate Dry	7580	7810	7720	7703	m^3/h
Wet	7660	7930	7870	7820	m^3/h
Flue Gas Temperature	40.1	36.0	39.3	38.5	°C
Mol. Weight Dry	28.8	28.8	28.8	28.8	kg/kg-mol
Wet	28.7	28.7	28.6	28.7	kg/kg-mol
Molar Water Vapor	0.00997	0.0147	0.0192	0.0146	
Particulate Conc.Dry	13.9	6.07	7.14	9.04	mg/dscm
Wet	13.7	5.98	7.00	8.89	mg/dscm
Dry	0.0118	0.00515	0.00606	0.00767	g/kg
Wet	0.0117	0.00507	0.00594	0.00757	g/kg
Particulate Emissions	0.105	0.0474	0.0551	0.0692	kg/hour
Conc. H_2S Dry	3.00	2.78	2.52	2.77	ppm
Wet	2.97	2.74	2.47	2.73	ppm
Emissions H_2S	0.0346	0.0331	0.0296	0.0324	kg/hour
Oxygen	20.9	20.9	20.9	20.9	percent, dry
Carbon Dioxide	0.000	0.000	0.000	0.000	percent, dry
Nitrogen	79.1	79.1	79.1	79.1	percent, dry

= 0.0292 g/s
Applied 3 x highest
0.105 g/s

(80%) of
= 0.00968 g/s
applied
0.012

Results corrected to 25°C and 760 mmHg where applicable.
Minimum detection limits have been used for sample results that were below detection limits.

Table 4: Parameter Test Results – Rotoformer E

Parameter	One	Two	Three	Average	Units
Date	Nov. 25/03	Nov. 25/03	Nov. 25/03		
Times Start	11:45	13:17	14:37		
Final	12:50	14:23	15:40		
Gas Velocity	16.7	16.7	16.7	16.7	m/s
Flow Rate Dry	7170	7150	7130	7150	m^3/h
Wet	7230	7220	7240	7230	m^3/h
Flue Gas Temperature	35.3	36.9	34.9	35.7	°C
Mol. Weight Dry	28.8	28.8	28.8	28.8	kg/kg-mol
Wet	28.7	28.7	28.7	28.7	kg/kg-mol
Molar Water Vapor	0.00819	0.00871	0.0151	0.0107	
Particulate Conc.Dry	18.4	0.496	2.85	7.25	mg/dscm
Wet	18.2	0.492	2.80	7.16	mg/dscm
Dry	0.0156	0.000420	0.00241	0.00614	g/kg
Wet	0.0154	0.000420	0.00238	0.00607	g/kg
Particulate Emissions	0.132	0.00355	0.0203	0.0520	kg/hour
Conc. H_2S Dry	0.161	0.159	0.142	0.154	ppm
Wet	0.159	0.157	0.140	0.152	ppm
Emissions H_2S	0.00175	0.00173	0.00154	0.00167	kg/hour
Oxygen	20.9	20.9	20.9	20.9	percent, dry
Carbon Dioxide	0.000	0.000	0.000	0.000	percent, dry
Nitrogen	79.1	79.1	79.1	79.1	percent, dry

Results corrected to 25°C and 760 mmHg where applicable.
Minimum detection limits have been used for sample results that were below detection limits.

PART 4 - DISCUSSION

There were no problems encountered with testing or subsequent data reduction.

Attachment 6: Letter to Alberta Health and Wellness

WorleyParsons Komex
resources & energy

Environment & Water Resources
8658 Commerce Court
Burnaby, BC V5A 4N6 Canada
Telephone: +1 604 298 1616
Facsimile: +1 604 298 1625
worleyparsons.com

10 December 2007

Proj. No.: C6272 00 00
File Loc.: Vancouver

Ms. Debra Hopkins
Alberta Health and Wellness
P.O. Box 1360, Station Main
Edmonton, AB T5J 2N3

Dear Ms. Hopkins:

RE: ALBERTA SULPHUR TERMINALS LTD. SCREENING REPORT

This letter is submitted to inform Alberta Health and Wellness of the scope of work to be initiated to conduct a screening of the products of incomplete combustion associated with the proposed Bruderheim Sulphur Forming and Shipping Facility (the Project).

A screening of the products of incomplete combustion will be conducted in the following stages:

- An emissions profile and emissions estimates for products of incomplete combustion will be developed for the Project;
- The emissions will be screened according to their cumulative toxic potency, with those emissions likely to generate the greatest risk identified as chemicals of potential concern for the health risk assessment. As well, compounds that have been previously identified as posing a potential risk to public health will automatically "qualify" for quantitative analysis in the HHRA (e.g., acrolein);
- Ground level concentrations will be modelled for the chemicals of potential concern;
- The results of the modelling will be evaluated to determine the risk to human health; and
- The risks will be described in a report to Alberta Health and Wellness.

We trust that this letter adequately describes the proposed scope of work for the screening of the products of incomplete combustion for the Project. If you have any questions or require any additional information, please do not hesitate to contact the undersigned.

Sincerely,
WorleyParsons Komex

Gillian Donald

Gillian Donald, Ph.D., P.Biol.
EIA Coordinator

Gordon Johnson
President

cc: Douglas Leahey
Bart Koppe
Ben Kucewicz
Rob Mann

Attachment 7: Risk Assessment 2005

Sulphur Management Facility
Bruderheim, Alberta

Risk Assessment

For

Alberta Sulphur Terminals Ltd.
A division of
Hazco Environmental Services Ltd.

Final Report

November 19th, 2005

Prepared By:

Doug McCutcheon and Associates, Consulting

PROFESSIONAL ENGINEER ALBERTA
DOUGLAS J. MCCUTCHEON
November 20/05

Professor Doug McCutcheon, P. Eng
10957 – University Avenue
Edmonton, Alberta, Canada, T6G 1Y1
Phone: 780 492 6931
Fax: 780 492 3409
Email: doug.mccutcheon@ualberta.ca

Doug McCutcheon and Associates, Consulting

Executive Summary:

The proposed project includes the handling of sulphur in a molten state, storing it and processing it to form pastilles in a way that significantly reduces the amount of sulphur dust needing to be handled. Included are systems to spray dust control material on the pastilles. It appears no other flammable materials are present.

The scenario determined for this review was a sulphur fire from a dust explosion or from spontaneous combustion of dusts in the pastille storage pile. Another scenario, H_2S exposures was not included as the data provided showed this to be not a concern.

The fire scenario was of concern as the sulphur would be converted to sulphur dioxide and in a toxic cloud from potentially drifting offsite towards the public. In order to characterize this scenario it was looked at in terms of how much sulphur dioxide would be released in the fire to have an impact 5 Km downwind. The number is around 1,400 Kg SO_2 would need to be released. The amount of sulphur needed to create this amount of SO_2 is not determined in this analysis but could be from process calculations. Many factors would come to play and determining the right scenario is needed to do this.

It is of note that the design of this particular process involves the use of molten sulphur and a design that does not require sulphur particles less than 400 microns in size. Particles may be produced in the solid handling part of the plant which is outdoors but sulphur dust that poses a dust explosion hazard is not expected. Generally dust explosions happen in confined areas like inside of buildings or covered processes. Good plant cleanliness and housekeeping can maintain a safe and acceptable condition.

Possible sulphur fires, usually as spontaneous combustion, are a potential concern for the production of SO_2 throughout the plant. The likelihood is there but detection and protective features are incorporated in the design to quickly mitigate any fire.

The probability of such an incident is within the guidelines that are set out by the MIACC organization and conservative as well. There is a need to recognize that design of the fire water system capabilities would very much need to include this worst-case scenario. This would include the pond size needed to put out a fire as well the pump capacity needed and back up capability. That controls and detection systems are needed for just this scenario. And, that personnel procedures and training need to include a fire scenario.

I am not familiar with the requirements of Lamont County for risk assessments. However the analysis shows me the risk would be within an acceptable range for what is recommended in Canada.

I hope this meets your needs. If there are any questions please contact me. Thank you for the opportunity to do this for you and good luck with your project.

Doug McCutcheon, P. Eng.

Appendices

1. Map of the Area & Process Drawings
2. Risk Management Process
3. Sulphur Data
4. Hazard Analysis
5. Consequence Analysis
6. Probability Analysis including
   - Uncertainty Analysis
   - Human Reliability Analysis
7. Risk Analysis
   - Individual Risk
   - Societal Risk
8. Conclusions & Recommendations
9. References

Appendix "1"

Map of the Area & Process Drawings

HAZCO ENVIRONMENTAL SERVICES LTD.

CONTOUR PLAN
FOR
SEC 35
TWP. 55 RGE. 20 W.4 M.
Lamont County
ALBERTA
2005
SCALE 1 : 5000

No.	DATE	REVISIONS / ISSUED	BY	CHKD
2	06/27/05	CONTOUR UPDATED WITH GPS DATA	RJJ	JES
1	06/07/05	REVISED AS REQUESTED	CSM	RJJ
0	05/27/05	ISSUED	RJJ	CHKD

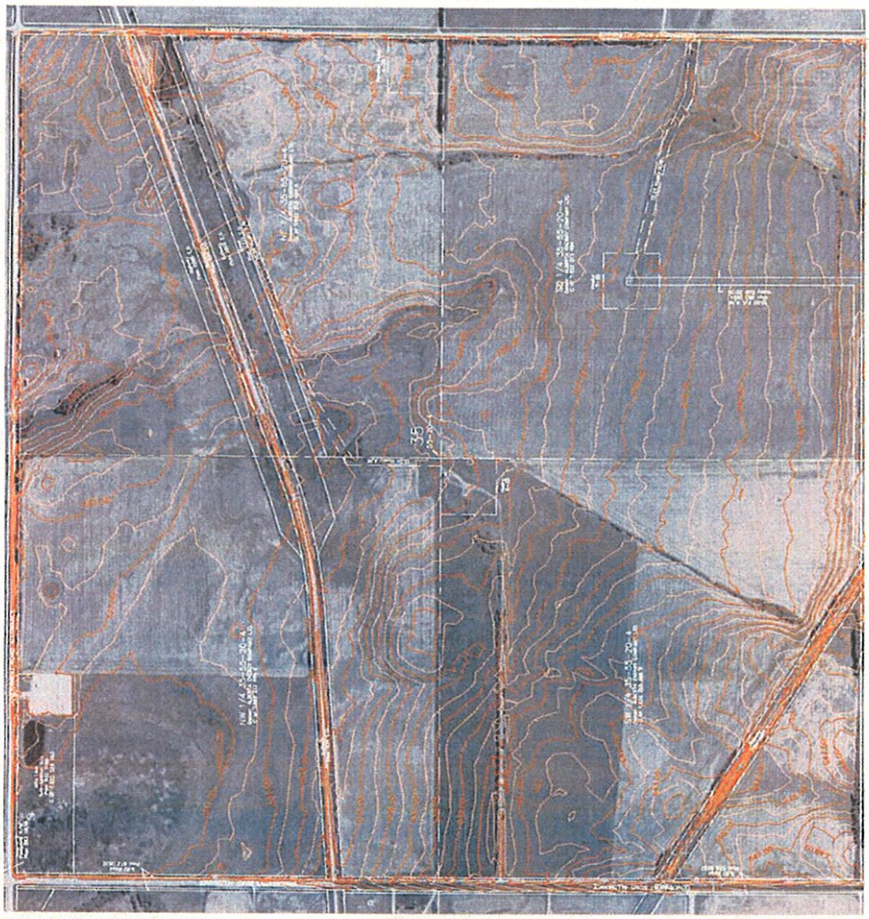
McELHANNEY IS NOT RESPONSIBLE FOR ANY OMISSIONS TO THIS PLAN CONCERNING BURIED CABLES, PIPES, ETC. LOCATIONS OF THOSE SHOWN ON THIS PLAN ARE APPROXIMATE AND ARE TO ASSIST IN THE PHYSICAL LOCATION AT THE TIME OF CONSTRUCTION.

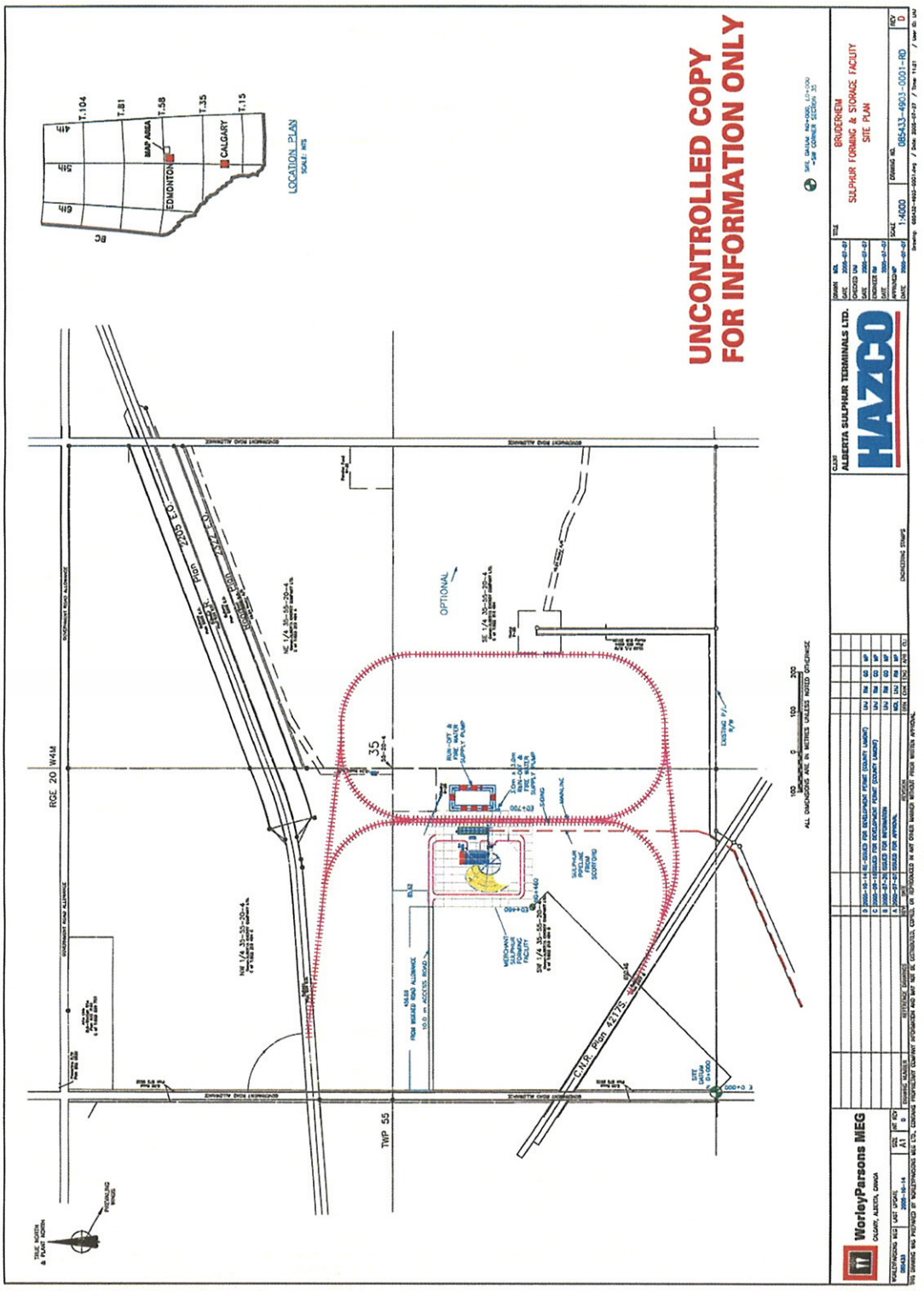
LEGEND :
- Elevations are in metres and Geodetic datum
- Contours are at 0.5m intervals

ABBREVIATIONS :
- A/R indicates access road
- P/L indicates pipeline
- W4 indicates Meridian
- N, E, S, & W indicates North, East, South & West
- R20 indicates Range
- R/W indicates Right-of-Way
- SW indicates Quarter
- Twp indicates Township

McELHANNEY LAND SURVEYS (ALTA.) LTD.
115, 5704 - 44th STREET, LLOYDMINSTER, ALBERTA, S9V 2A1
PH: (780) 875-4651 FAX: (780) 875-4188

Job No: 3411-08420 | DWG. File No. 08420GRID1

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FOR INFORMATION ONLY
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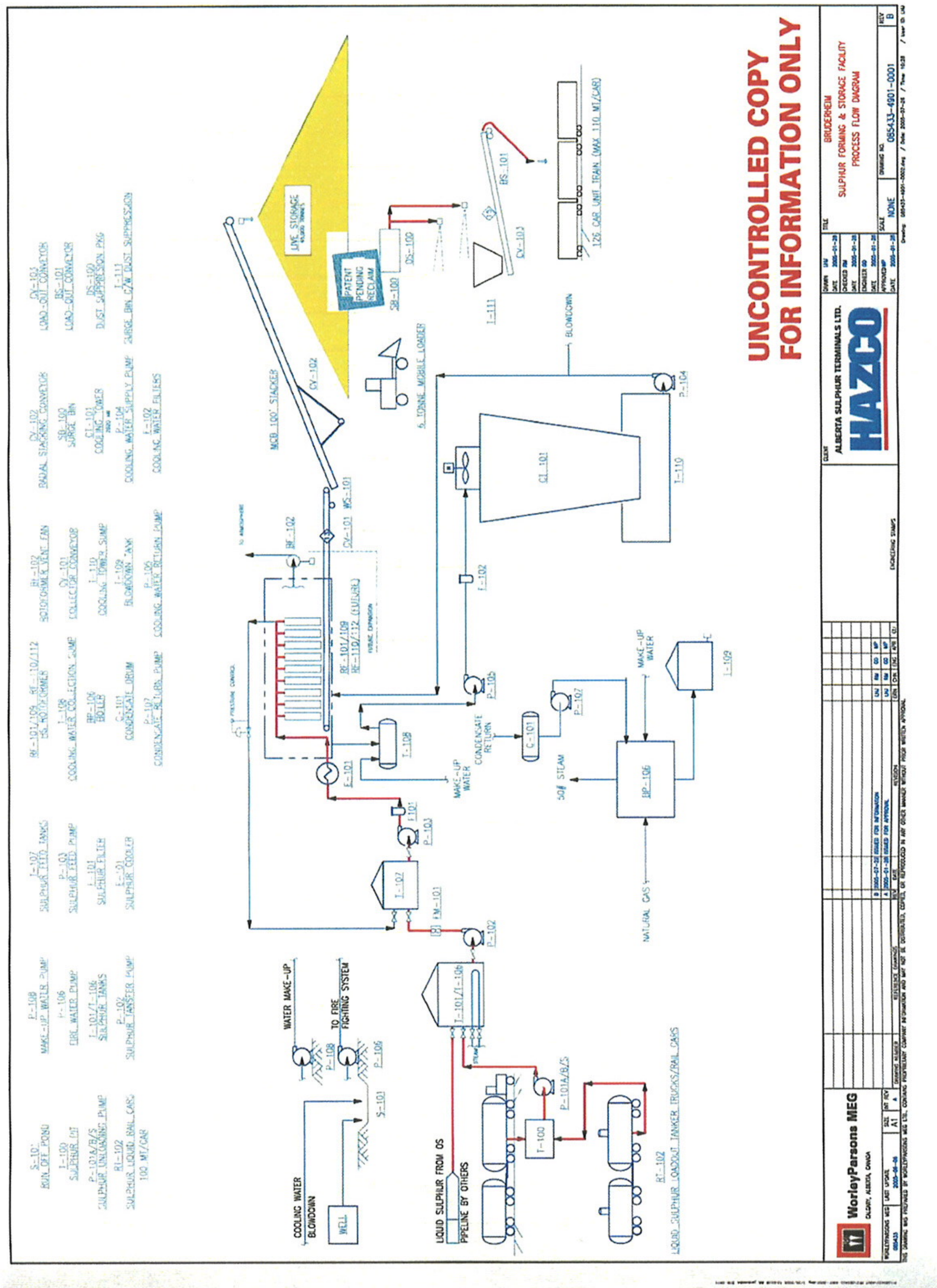
CALGARY
T.104
T.81
T.58
T.35
T.15
BRUDERHEIM
SULPHUR FORMING & STORAGE FACILITY
SITE PLAN
ALBERTA SULPHUR TERMINALS LTD.
HATCH
WorleyParsons MEG
RGE 20 W4M
TWP 55
C.N.R. plan 42175
OPTIONAL
ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE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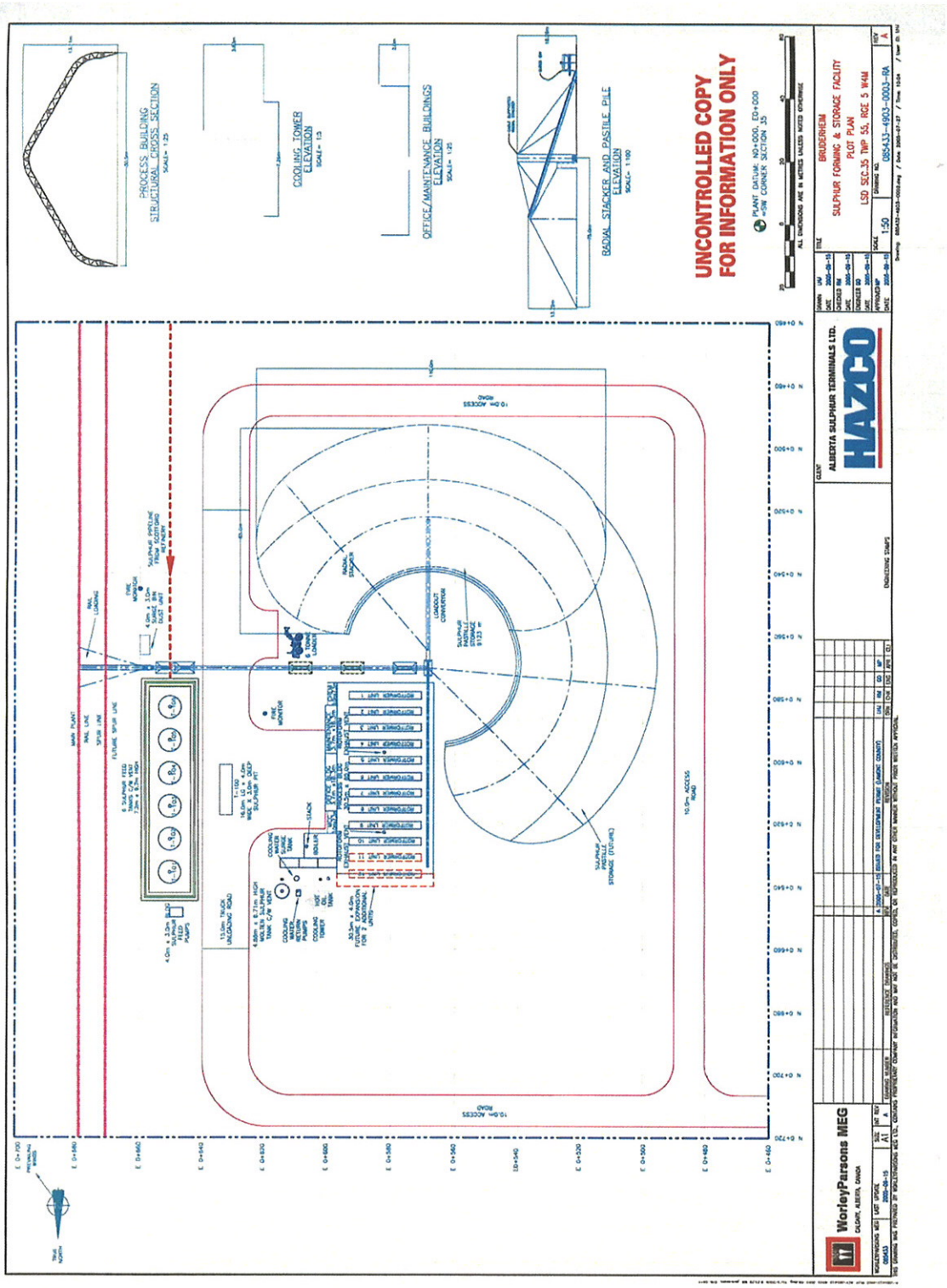
FOR INFORMATION ONLY
ALBERTA SULPHUR TERMINALS LTD.
HAZCO
WorleyParsons MEG
BRUDERHEIM
SULPHUR FORMING & STORAGE FACILITY
PROCESS FLOW DIAGRAM
085433-4901-0001
LIQUID SULPHUR FROM OS
PIPELINE BY OTHERS
WATER MAKE-UP
TO FIRE FIGHTING SYSTEM
COOLING WATER
BLOWDOWN
WELL
NATURAL GAS
LIME STORAGE
PATENT PENDING RECLAIM
126 CAR UNIT TRAIN (MAX 110 MT/CAR)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PROCESS BUILDING
STRUCTURAL CROSS SECTION
COOLING TOWER
ELEVATION
OFFICE/MAINTENANCE BUILDINGS
ELEVATION
RADIAL STACKER AND PASTILLE PILE
ELEVATION
BRUDERHEIM
SULPHUR FORMING & STORAGE FACILITY
PLOT PLAN
LSD SEC.35 TWP. 55, RGE. 5 W4M
ALBERTA SULPHUR TERMINALS LTD.
HAZCO
WorleyParsons MEG

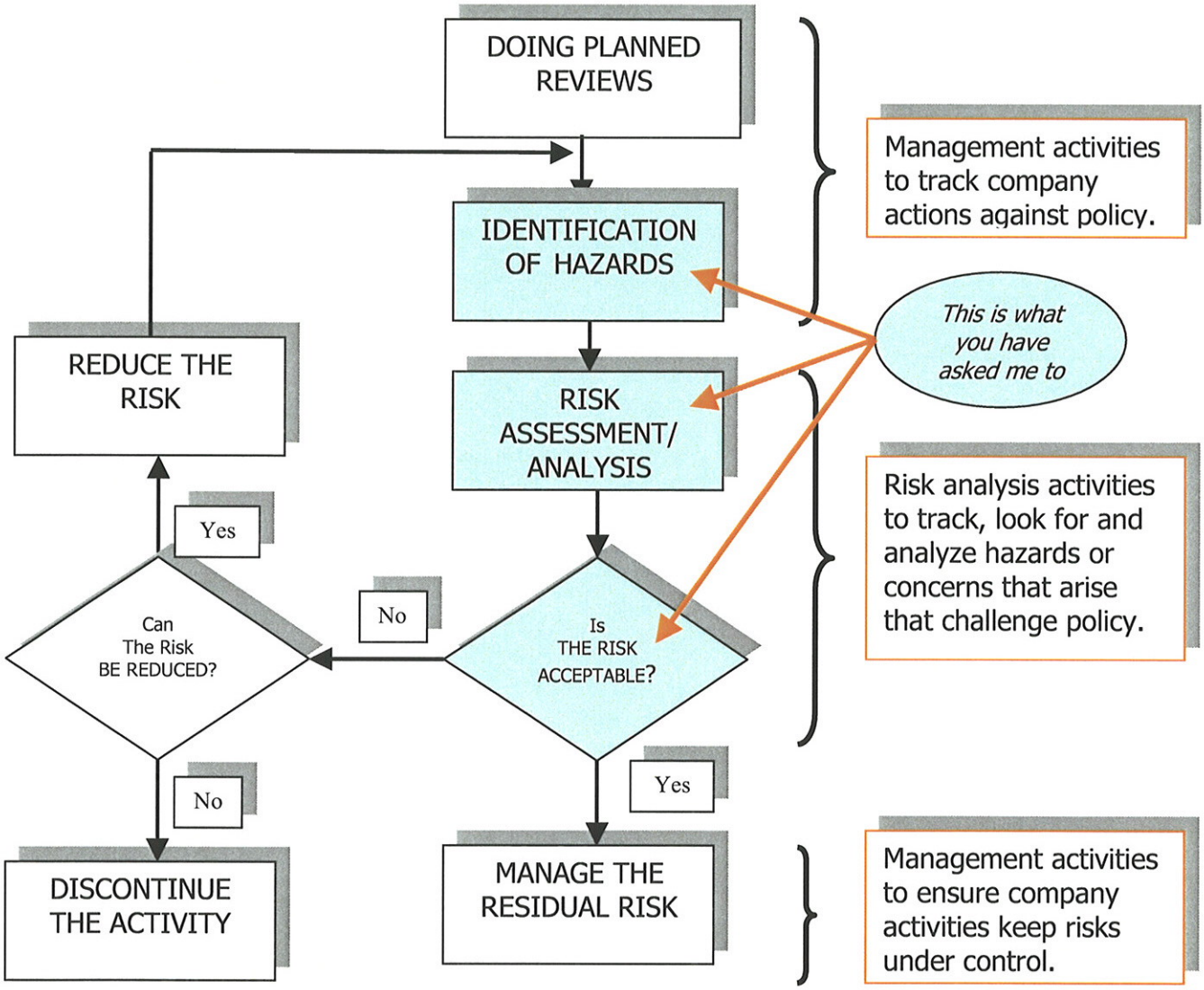
Appendix "2"

Risk Management Process

The Risk Management Process

The process used to do Risk Assessments follow this globally accepted methodology. The proposal presented above is in line this method.

This risk management process represents what is practiced around the world particularly for hazardous industries but including others. Each step requires different activities to be conducted in differing formats. The result is a process that has been used successfully globally for over20 years and is considered to be the best we currently have.



What does each box mean?

1. Doing Planned Reviews:

This is a management function. Here you would be conducting what ever reviews you need to do that will provide the data needed to monitor your operations or new project designs. Here is the database for your safety and loss management system. It would include incident investigations, insurance company reviews; regulatory activities (pressure vessel inspections, environmental reporting, asset renewal needs, changes to laws, code updates, etc.). Not to mention the regular data you collect on your business operations and maintenance activities. The point is you want to be proactive so gathering the data and doing trend analyses in conjunction with statistical analyses will keep you ahead of trouble.

2. Identification of Hazards:

One of the outcomes of doing the reviews you mandate as a management team as well as listening to industry activities in general through associations and the news, will be the identification of hazards (or for a better term concerns). Your management team will receive the data and in the wisdom of the team will determine what needs to be further analyzed through doing a risk analysis or analyses.

You may wish to do formal reviews of projects for hazards and this is where a Hazard and Operability Study (HazOp) will come into play. Other tools are available but for the processing industries HazOp's are well thought of. A HazOp can be done on an existing process as well.

3. Risk Assessment/ Analysis:

There are many tools available to help do the risk assessment (risk analysis). There are many tools available to quantify the consequences of all kinds of hazards. Explosions, toxic cloud dispersion models, toxic exposures, lethality, noise, water pollution plumes, etc. etc. All these provide the consequence data you would need to make the right choices.

Probability is one where it pertains to the failure of systems, humans, equipment, etc. Data is available generically but the best data is in your database with respect to maintenance records and operational records. Probability (frequency) is also very quantifiable.

4. Is the Risk Acceptable?

Most company management have developed a risk matrix describing what is a low (acceptable) level risk, medium (acceptable with certain conditions) level risk and High (unacceptable) level risk.

These matrices clarify to employees what they must do and what is acceptable. The low-level risks are usually acceptable without any further management involvement or design additions. Medium risk is the one where management needs to be involved to ensure the risk is kept under control and it is worthwhile noting here

management's responsibilities come to the front line as they are assuming the responsibility for taking the risk.

5. Manage the Residual Risk:

Once a risk is determined to be acceptable it must be managed. This is the largest box in the process as you now have the responsibility for assuming the risk and preventing any incident from happening. This is outlined further in the Process Safety Management systems, which are found around the world as the accepted methods for managing risks.

These consist of 10 – 20 program elements that must be carried out to manage the risks in an acceptable way. Don't forget that once a risk is accepted it does not go away. It is there waiting for an opportunity to happen unless your management systems are actively monitoring your operation for concerns and take proactive actions to correct potential problems.

6. Can the Risk be Reduced?

Often there are ways to reduce the risk once a risk is determined to be unacceptable. The term "Inherently Safe" implies methods, which will eliminate the risk. Further controls, management systems, protective features, etc. can be added to reduce the risk to an acceptable level.

7. Reduce the Risk:

If the proposed change is viable then do the necessary changes.

Note that once the change is made the process is once again used to evaluate for possible new hazards and risks. Changes in processes often create potential problems upstream or downstream. If they are not uncovered your operational risk may go up unknowingly to yourselves.

8. Discontinue the Activity:

A very important step is to recognize the risk is too high. Management needs to be clear on this one and make the right decisions. Company values, objectives, etc. all come to play in this box including the idea of lost profits, personal promotions, professional defeat, etc.

This statement is a key one because it says you will not do something that is unsafe, pollutes, damages assets, risks you business needlessly, or impacts the public's view of you negatively. Also, your employees are watching your performance and their support for your management decisions is something you need.

Appendix 3

Sulphur Dust Data

Dusts are a known hazard however they are often overlooked or given less emphasis when compared to flammable gases. Dusts are more of a nuisance that need to be dealt with in process designs and usually fall into the category of housekeeping issues or environmental protection needs. For this reason there is not always an appropriate level of attention paid to the consequences of a dust cloud explosion in process designs. But, flammable dust clouds actually contain far more potential energy than the same volume of a flammable gas mixture. Once this is discovered during the evolution of a project acceptable measures can be taken which would include direction from the National Fire Protection Association (NFPA) or regulatory bodies.

A typical dust explosion will begin with a small explosion, which will serve to agitate the remaining dust material (usually piled), into a cloud. This secondary cloud normally contains more of the dust material and consequently creates a larger explosion. Because there is a lot of potential energy in the dust particles the second explosion is usually much more violent and releases a significant amount of energy over a very short period of time (a fraction of a second). Often the energy release is so fast it will cause significant damage.

It is not easy to design relief systems to protect the operating equipment and personnel involved with the operation. It is common to see large filters, with very large explosion vents or several explosion vents along the process route. Because of the amount of potential energy that could be released these vents must be large in area in order to protect the connected process equipment.

Further an explosion needs to have three components, fuel (dust), oxygen (air) and an ignition source. For a solids handling system it is much more difficult to control these components than a flammable gas system. The controls tend to be mechanical in nature prone to wear and leakage.

1. The control of the dust is often by containing the material inside of equipment with designs to minimize the ability to provide places for piles of dust particles to build. Control is very much looking for leaks in the containment and housekeeping procedures.

2. Oxygen is often controlled through the addition of inert gases such as nitrogen (N_2) or carbon dioxide (CO_2) at planned points in the process. Ensuring a homogenous environment with enough inert gas at all locations is a challenge, particularly if the process is a mechanical one (like this process) where leaks are possible along the process trains.

3. Ignition sources such as open flames, electrical sparks, smoking, or use of maintenance equipment can be controlled. However, the real challenge is the static discharge potential. Dusts will create static as the particles

travel along the process rubbing against equipment walls. The use of conveyor systems will generate static charges. Unless these charges are dissipated enough of a charge can be stored that when released enough energy can be provided to ignite a cloud. This is of particular concern for Sulphur because the Minimum Ignition Energy (MIE) level is very low compared to other dust particles.

Sulphur Dust Cloud Flammability:

Dust is defined as a finely divided solid of 420 microns (40 mesh) or smaller. It is also common to use the term "fine dust" (30 – 100 microns) and dust as 100 – 300 microns. For this review it is reasonable to be looking at the "fine dust" category, as the purpose of the grinding process is to reduce the sulphur particle to 74 microns (200 mesh). It is also important to recognize all dispersed dusts in air containing sulphur can be ignited.

Dust flammability data is gathered through experimentation. The smaller the particles the more reactive they are. "Fine dusts" react more violently that course dusts. Generally dusts greater than 400 micron (40 mesh) cannot be caused to explode.

The lower explosive limit (LEL) for sulphur dust in air is 35 g/m^3. Of note is that many dusts are barely visible at the LEL. Also, the ignition energy required for an explosion at the LEL is several orders of magnitude higher than at the stoichiometric concentration in air. Finally the pressure rise and rate of pressure rise (measures of explosive power) are fairly small at the LEL concentration.

As the concentration approaches stoichiomentric (the exact amount of oxygen and sulphur needed to consume each other), the dust is so thick it is hard to see further than a few feet. The data shows that here the ignition energy needed is still above the minimum value and the pressure rise and rate of pressure rise are still below the maximum. It is found the maximum explosion pressure and rate of pressure rise is 2 – 3 times the stoichiometric concentration (about 70 – 100 g/m^3). Note that the ignition energy needed decreases above the stoichiometric concentration. This probably describes the conditions that exist inside the filters or even any grinding processes. Which makes these two parts of the process more susceptible to an explosion and fire.

Sulphur dust has an LEL of about 30 - 35 g/m^3 at 20°C (ambient). As the temperature increases the LEL declines, not surprisingly as this is the case for flammable gases and liquids.

Some interesting data for sulphur dust:

- LEL = 30 g/m^3 (low)
- Minimum ignition temperature (dust cloud) = 190°C (very low)

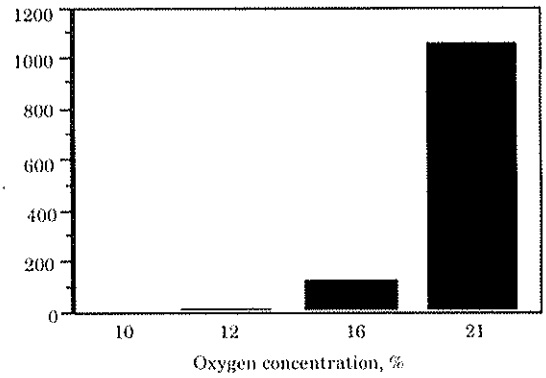
- Minimum ignition temperature (layer) = 220°C
- Minimum Ignition Energy (MIE) = 15 mJ (low)
- Maximum explosion pressure = 78 lb_f/in^2 (moderately low)
- Max. rate of pressure rise = 4,700 lb_f/in^2 sec. (moderately low)
- The "cubic law constant' or "Staub constant", Kst = 151 *which puts in the St-1 class rating a sulphur dust explosion as a weak explosion.*

Oxygen Concentration:
Inerting with carbon dioxide or nitrogen will reduce the explosive range, as would be the case for other means of reducing the oxygen concentration. Also of note is the lower oxygen concentration will mean a lower pressure rise and rate of pressure rise. Generally for organic dusts reducing the oxygen concentration to 10% will make a dust explosion impossible. However of note is for sulphur that value is 7% (9.3% in NFPA). This makes sulphur a very real concern for the design process.

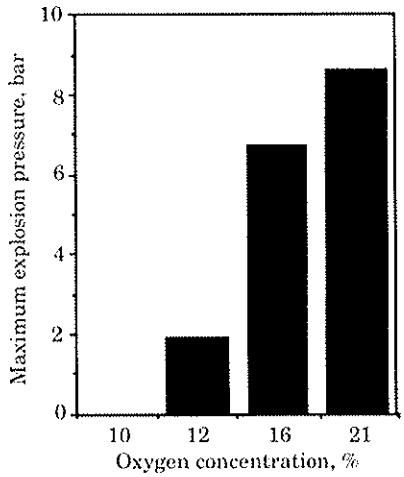
Ignition Energy and Static Electric Discharge Energy:
Minimum Ignition Energy (MIE) is defined as the lowest electrical energy stored in a capacitor which when, discharged over a spark gap, barely ignites the most readily ignitable dust/air concentration at ambient pressure and temperature. In general it is safe to say dusts have a much higher MIE than flammable gases measured at 100 times that of a flammable gas. And the finer the dust the less energy needed.

Ignition temperature is the lowest temperature of a hot surface that will ignite the most readily ignitable dust mixture in air. Hot surfaces account for about 6% of explosions and should not be eliminated as a source too early in an investigation. For dust layers it is noted an ignition temperature of only 190°C is needed, which is easily attained in a spontaneous reaction (i.e. a self-heating reaction in a pile of sulphur dust).

Also, if one is to look at the impact of higher temperatures lowering the LEL then the ignition energy from a hot surface can become a factor if it is mechanically generated. That is if a metal piece, say from one of the filter sock baskets were to fall and create a spark. I don't know if these types of filters are used but I assume a filtering system for the plant process area ventilation system will be in place. And that the temperature the filters will be operating at above 20°C this means the LEL for sulphur dust will likely be lower than 30 g/m^3.



igure 14: MAX dp/dt in reduced oxygen for calcium stearate. (Bartknecht 1981)



igure 15: Effect of oxygen concentration on explosion pressure with calcium stearate dust. (Bartknecht 1981)

dusts. (Bartknecht 1989)

Dust type	Median particle size, micrometers	LOC Oxygen (Limiting Concentration) vol %
Peaflour	25	15.5
Hard coal	17	14
Barium stearate	<63	13
Brown coal	63	12
Soot	13	12
Organic Pigment	<10	12
Calcium stearate	<63	12
Wheat Flour	60	11
Polyacrylonitrile	26	11
Cellulose	22	10.5
Wood	27	10
Methylcellulose	70	10
HD Polyethylene	26	10
Bisphenol A	34	9.5
Corn Starch	17	9
Sulfur	30	7
Paraformaldehyde	23	6
Aluminum	22	5

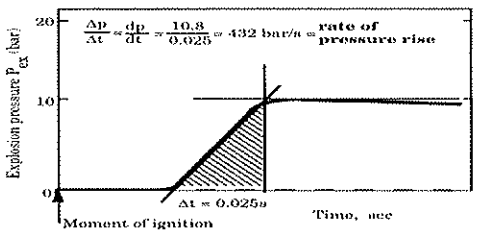


Figure 3: Definition of the rate of pressure rise of a dust explosion (any concentration). (Bartknecht 1989)

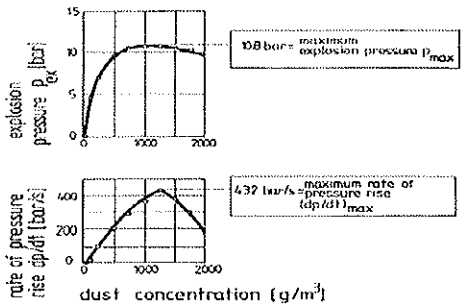


Figure 4: Determination of the peak explosion characteristics of combustible dusts. (Bartknecht 1989)

SUMMARY:
When looking at the physical and chemical data in more detail it becomes more obvious that sulphur explosions and fires have some specific concerns. The lower oxygen content needed to form an explosive mixture may be a factor to consider around selection of the nitrogen source and the location of nitrogen addition points.

Included in any analysis of the physical properties is the need to determine the consequence of a fire. That is what will the sulphur turn into in a fire? In this case sulphur when burned with oxygen forms sulphur dioxide. Sulphur Dioxide is very toxic and will have an impact on workers as well as the neighbouring community.

There are no other chemicals of concern.

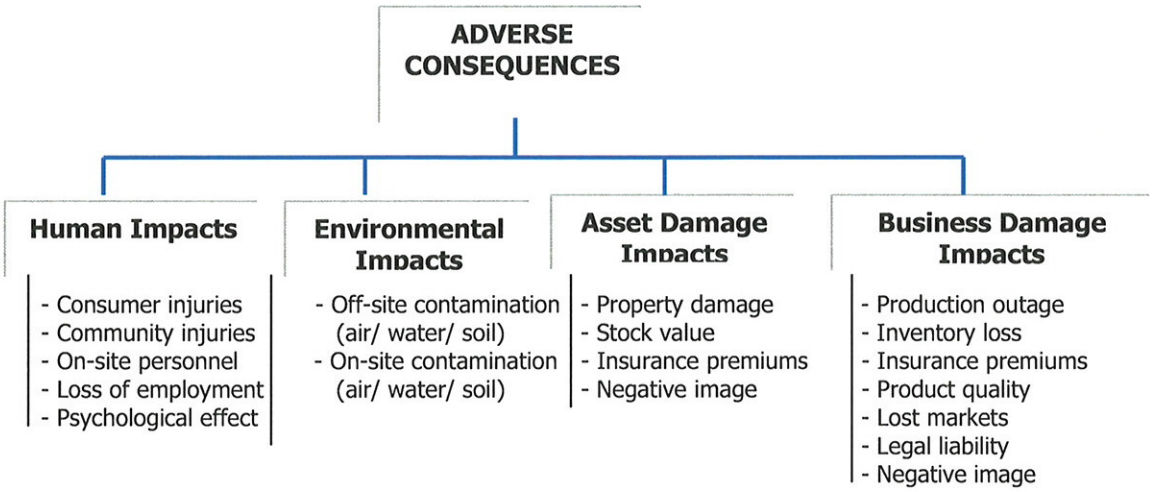
The fact that a lower level of energy is needed to ignite a sulphur cloud and the temperature of a hot surface (roller or bearing on a conveyor, or metal parts rubbing together) can cause an explosion may be cause for further investigation of the equipment manufacturers design, and the addition and type of fire protection features needed in the plant design to address these risks.

Appendix "4"

Hazard Analysis

Every risk assessment needs to begin with the identification of hazards. These types of hazards are then evaluated in terms of the impact they could have on the community. The chart below describes the type of hazard and possible concerns over the impact

Hazard identification involves the identification of specific undesirable consequences. They can be broadly classified as human impacts, environmental impacts, asset damage impact and business damage impacts. These are relatively straightforward and not difficult to identify. However being thorough in the review is necessary in order to ensure all hazards are uncovered.



Potential hazards to consider include:

Fire	Explosion	Detonation
Corrosion	Toxicity	Radiation
Noise	Vibration	Noxious Materials
Electrocution	Asphyxia	Mechanical Failure
Environmental Impact	Security Breach	Lost Company Image
Insurance Cost Impact		

Most hazards are seen as personnel safety issues as they pertain to the workers in the particular company operation and rightfully so as they are exposed to the hazards in their daily work activities. Management must be mindful of this priority and focus on the protection of the workers in the field. However some may have an impact beyond the "fence-line" of the company's operations.

To get back to the issues that do affect the public these cannot be ignored. Again the public has a huge impact on company business. Many of the guidelines and standards of design and operation including regulations are designed to protect the public. Paying attention to meeting these criteria is very important. Certainly immediate danger to the public is a priority and an important focus. But equally important are the long-term health effects, which may not be obvious until it is too late. So paying attention to the current scientific and medical knowledge is important too.

It may be useful to look for hazards by breaking them down into components. Hazards are made up of the three following components:

- The first is a source of energy such as kinetic energy (anything that's moving), gravity (anything that can fall), thermal, environmental conditions, flammable, toxic or corrosive chemicals, toxic or oxygen deficient atmospheres, pressurized gases or liquids, electrical, stored energy, etc.

- The second component of a hazard is any circumstance or mechanism that can cause the energy to be released in an unplanned or uncontrolled manner. Examples are explosions, workplace conditions, equipment failure, tripping and falling, weather, and contact with moving parts or equipment or machinery.

- The third component of a hazard is the presence of a body, object, material, etc. that can be impacted and harmed by the uncontrolled release of energy.

Here are some calculated values that can be used to understand more clearly the impact of an incident. We have the ability to determine how much energy can be released from almost any incident, having the knowledge of the consequences as shown below makes for better decision making. These represent just some consequences of concern. Other tables can show consequences of other incident types (like electrical, mechanical, etc.).

TYPE OF INCIDENT	CONSEQUENCE Odour/Irritation Threshold	CONSEQUENCE Irreversible Effects Threshold	CONSEQUENCE Life Threatening Effects Threshold
Toxic Release (concentration - 1 hour exposure)	ERPG-1	ERPG-2	ERPG-3
Fireball - Immediate Ignition (radiation intensity - 60 second exposure)	1st Degree Burns 2 kw/M^2 600 BTU/hr/ft^2	2nd Degree Burns 5 kw/M^2 1600 BTU/hr/ft^2	3rd Degree Burns 8 kw/M^2 2500 BTU/hr/ft^2
Flash Fire - Delayed Ignition (flammable gas dispersion)	NOTE there is no lower level consequence	1/2 of Lower Flammability Limit	1/2 of Lower Flammability Limit
Pool / Jet Fire (radiation intensity - 90 second exposure)	1st Degree Burns 1 kw/M^2 400 BTU/hr/ft^2	2nd Degree Burns 4 kw/M^2 1200 BTU/hr/ft^2	3rd Degree Burns 6 kw/M^2 1900 BTU/hr/ft^2
Unconfined Vapor Cloud Explosion (overpressure)	Window Breakage 0.3 psig 0.02 bar	Partial Demolition of Houses 1.0 psig 0.07 bar	Threshold of Ear drum rupture. Lower limit of serious structural damage 2.3 psig 0.16 bar

Some Definitions

Kw/M^2: is kilowatts per meter squared. A measure of heat energy over a surface area.

Psig & bar: are measures of pressure

ERPG-1: is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for one hour without experiencing other than mild transient adverse health effects or perceiving a clearly objectionable odour.

ERPG-2: is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing any irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.

ERPG-3: is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects.

Note, in the Simplified Risk Management Process (Appendix "2"), unless a hazard is identified there is no reason to do a risk assessment. Which makes sense. As is the case for management processes in general a flow of information and

activities is what it is all about. So, put another way, only do the risk assessments when a hazard is noted.

Through a review of the information provided, it was determined the following hazards were considered for this report:

Types of Hazards	Consequence External to the Site
Sulphur Pile Fire	Yes SO_2 and possible H_2S exposure
Truck Transportation Incident	Local incident environmental concern
Railroad transportation Incident	Local incident environmental concern
Pipeline release through rupture or leak	Local incident environmental concern
Dissolved H_2S released from molten sulphur	Possible annoying odours
Possible flammability of H_2S if allowed to collect inside equipment	No offsite exposure
Sulphur dust explosion	Yes SO_2 and possible H_2S exposure

Specifically the major hazard with an impact beyond the fence-line of the facility is a sulphur fire brought on by a sulphur dust explosion or event that causes the sulphur pastilles to catch fire. Also considered is a molten sulphur release; however the molten sulphur is to contain no more than 10 PPM of H_2S. There may be an odour concern (ERPG–1 = 0.1 PPM) but it is not expected to be a people exposure hazard (ERPG–2 = 30 PPM and ERPG-3 & IDLH = 100 PPM).

With the fire scenario as the source of concern a look at the content of the combustion products is what constitutes the hazards. Sulphur when burned in the presence of O_2 (air) will produce SO_2 (Sulphur Dioxide). The question is how much Sulphur is needed to burn to create a toxic cloud that would impact off site. The ERPG-2 value is generally used as a measure of this hazard. ERPG-1 is usually the "odour level"

The most likely source is the sulphur dust explosion scenario. Here there is potential for damage to equipment and protective features which could impair an effective emergency response. The knowledge that there is fire potential indicates a strong need for effective dust control methods, grounding of equipment at all possible ignition sources and a firewater system designed for the very worst case sulphur fire scenario.

With the understanding of what a hazard is "the potential source that can cause harm to people", we can now move on to determine if it is an acceptable level of risk or not.

Appendix "5"

Consequence Analysis

The next step is to investigate the consequence of the sulphur fire. As noted in the hazard analysis spills of molten sulphur are not considered as a concern except for local environmental needs. The major concern is a sulphur dust explosion resulting in a fire.

Endpoint (definitions):

- For toxic chemicals the "endpoint" is the concentration in air of the chemical that is at or below the chosen level (often the ERPG 2 value for that chemical). IDLH is also used as a measure.
- For toxic chemicals odour the "endpoint" is the concentration in air of the chemical that is at or below the chosen level (often the ERPG 1 value for that chemical).

Release Scenarios:

Included is the calculation of the effect of a SO_2 release as a result of a fire. This analysis looks at what quantity of SO_2 is needed to have an impact downwind rather than to look at the results for a specific scenario. Not knowing the quantities of sulphur in process or in storage at any one time this method should serve to characterize the consequence analysis.

Atmospheric Conditions:

All releases are subject to different scenarios depending on the atmospheric stability at the time of release. Atmospheric stability categories are basically used to describe turbulence. When modeling differing scenarios assumptions need to be made around time of day, wind speed, cloudiness, and the sun's intensity. There are six (6) categories denoted by the letters "A" through "F", with "A" being very unstable, "D" being neutral and "F" being very stable. "D" and "F" are typically used for the Edmonton area.

Toxic Cloud Release:

Used a set of tables provided by the EPA-RMP program to determine the distance from the leak source that would be impacted for ERPG-2 endpoint conditions. Odour calculations were also looked at.

ERPG-1: is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for one hour without experiencing other than mild transient adverse health effects or perceiving a clearly objectionable odour.

ERPG-2: is the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing any irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.

*(*Emergency Response Planning Guidelines - published by the American Industrial Hygiene Association")*

The scenarios considered the release of the quantities of the two chemicals for two time frames (10 minutes and 60 minutes). This gives a range of distances to evaluate.

Approach to Attempting to Determine Worst-case Scenarios

In order to help quantify the impact area of a major incident I used two tools to create my own areas of impact. Here I took the chemicals involved (H_2S and SO_2) and tried to calculate a rough quantity of material that would have an impact at varying distances (up to 10 Km) from the source. The two tools used were the Dow Chemical Exposure Index 2nd edition and the EPA-RMP rule look up tables plus the EPA-COMP program for calculating distances. See below for the analysis.

To evaluate the extent of exposure I considered the distance that a release of 1,000 Kg of material would impact for an ERPG-2 concentration as shown in Table "1" below. I also calculated how much would be required to have an impact of ERPG-2 concentration at varying distances up to 10 Km. The 1,000 Kg release seems to me to be a realistic scenario. While the quantities are somewhat higher for the 10 Km distance they are not unrealistic for sulphur dioxide. It seems to me the public can be exposed to high enough concentrations to require shelter-in-place or evacuation during an emergency event if they are within the area.

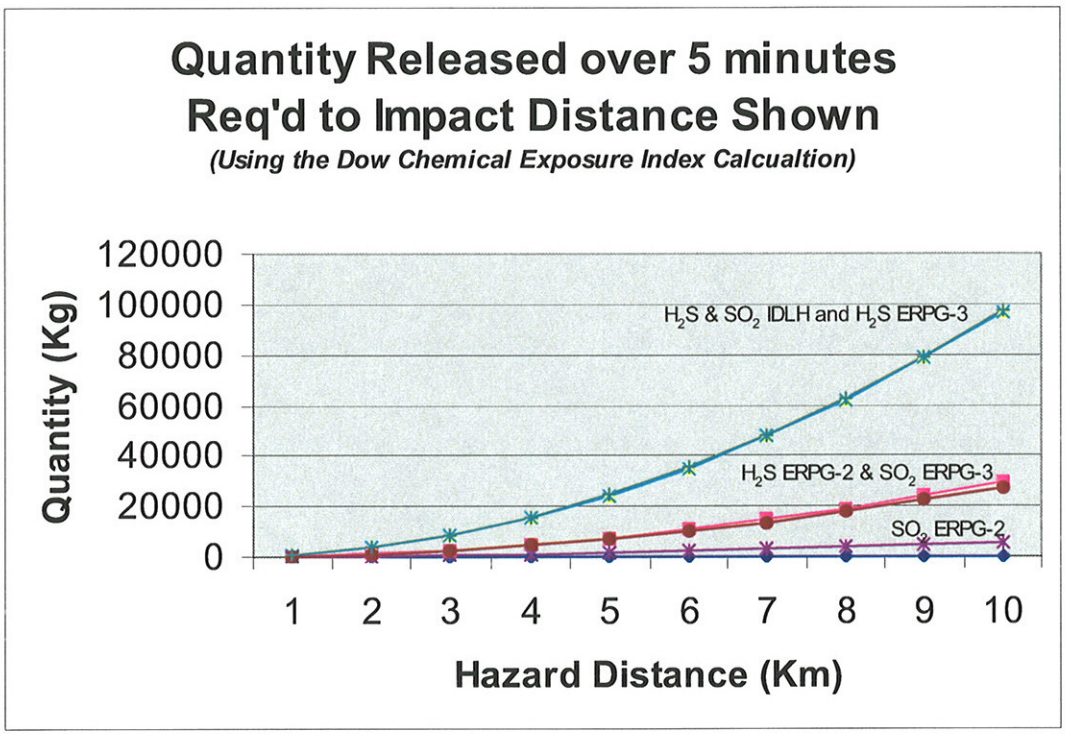
Chemical Involved	Distance from the source of the release to ERPG-2 for a 1,000 Kg release	How much material would be needed to impact 10 Km out to the ERPG-2 value
Hydrogen Sulphide (H_2S)	2 – 5 Km.	30,000 Kg.
Sulphur Dioxide (SO_2)	4.5 – 5.5 Km	4,000 Kg.

Not having access to the actual quantities it makes it difficult to determine if there is an impact that would be felt well beyond the fence line. However by taking the approach of "how much material is needed to impact at a distance of 10 Km. at a level equal to the ERPG-2 concentration it appears (as shown in Table #1) that these quantities could be realistically held on site. Certainly quantities lower would have impact and more impact than 1.0 Km. Therefore the Emergency Planning Zone (EPZ) should consider these distances...

The use or ERPG-2 allows for effective emergency preparedness and response by allowing a one-hour exposure to lower levels of the chemicals where no adverse health effects can be seen. This means people can have time to find shelter ("Shelter-in-Place") and they will not have their sense of reasoning impaired by the exposure.

In order to determine if a hazard exists an approach to see just how much H_2S and SO_2 would be required to impact community neighbours (about 5 Km max. away from the site location) was used. As well the values for ERPG-2 were used as these pertain more readily to emergency planning.

The graph below points out that for H_2S and SO_2 to have an impact downwind, releases of 7,350 Kg of H_2S and 1,400 Kg. of SO_2 would need to happen. Certainly within that 5Km radius most of the community members reside.



Health Effects:
For both molten sulphur and Sulphur Dioxide the health hazards are immediate and severe when exposed to them. No other long-term health hazards for low-level exposures are noted. For Hydrogen Sulphide it has the same concerns and is fatal at low concentrations. No other long-term health effects for low-level exposures were noted.

Conclusions:
There is enough sulphur on site to create an offsite impact if a fire were to happen. The resulting SO_2 toxic cloud could likely impact local residents. Therefore it is important to develop a "worst-case" scenario for a dust explosion and fire or sulphur pastilles pile fire. That scenario should be used to calculate the requirement for water from the fire water system and the resulting pond and fire water pump capacities.

Human Vulnerability Criteria:
When looking at the types of incidents some have more impact than others. For example if you are standing within the circle of impact for an explosion or fire you can expect the probability of death to be very high approaching 100%. If you are in the area of a toxic cloud release it will depend on the size of the release, the wind direction and if people in the affected area take action to save themselves. For this analysis I will not get into a detailed calculation but simply mention that the resulting level of risk are the worst case scenarios and any action taken by people to save themselves will only serve to reduce the risk.

If there is a toxic gas release, there will be time to react and people will be able to evacuate the area. If this is not possible then sheltering inside the building is an accepted emergency measure. In all cases the vulnerability is minimized.

Appendix "6"

Probability Analysis

- Uncertainty Analysis
- Human Reliability Analysis

Probability Calculations:

From a probability view the consequences can be different for the many varieties of activities happening in the process. However the main concern is the dust explosion and fire. As well, spontaneous combustion of accumulated dust in the Pastille pile. Both are a function of housekeeping standards and operational logistics. To attach a probability to this would be very difficult. Management practices and procedures are the issues here. If neither were attended to it would be quite likely there would be an explosion and fire.

Failure Data for several situations have been identified through various analyses around the world. Below are a few databases, which would be appropriate for these circumstances.

Type of failure	Canvey Report # Incidents / year	Rijnmond Report # Incidents / year
Pipe leak	3×10^{-4} /km	1×10^{-8} to 1×10^{-10}
Tank leak		1×10^{-4} to 6×10^{-6}
Railcar derail & spill	1×10^{-6} /km traveled	
Pump failure	1×10^{-4}	1×10^{-4}
Ton cylinder leak		1×10^{-5} to 1×10^{-6}
Hose failure		4×10^{-5} to 4×10^{-6}
Valve opening (relief valve)		1.4×10^{-5} to 3.6×10^{-5}
Truck road spill incident	1×10^{-8} /km traveled	

Data from the UK HSE analysis of incidents 1978 and from the Netherlands review 1982 for Rotterdam link to the North Sea.

Type of failure	Center for Chemical Process Safety Mean Time Between Failures (MTBF)
Operator error (serious incident)	252,000 hours or once per 28 years
Detection system failure	220,000 hours or once every 25 years
Truck loading or unloading failure	1,156,000 hours or once every 131 years
Spills and leaks	148,000 hours or once every 17 years
Process control system failure	167,000 hours or once every 19 years

Data from an analysis of LNG plants by CCPS (1 year = 8,760 hours)
Data is also per person, per system, per truck operation, per tank.

I have shown several types of data to represent the normal probabilities of operating hazardous facilities, which may be of use. I think the major point being the likelihood of an incident happening very much is a management issue here because of the human factor possibilities. By looking at the data human factors can be in the order of 1 in 28 years which = 3.5×10^{-2} per year, if there is no detection system or control system in place. If there is detection and control the probability will be in the order of $(1/28)(1/25)(1/19) = 7.5 \times 10^{-5}$.

The above analysis is saying an incident can happen where dust is released in an area where an ignition source exists and oxygen is present. Where the detection systems, process control system and the operator fail to take action. It is recognized that ignition does not always occur. In fact it is a 1/10 chance that ignition might occur. This means the probability could be as low as 7.5×10^{-6}.

Alberta Historical Analysis of Highway Dangerous Goods Incidents - 1991:

Abstract of Paper

Alberta Public Safety Services is the provincial department concerned with the transportation of dangerous goods on Alberta highways, the enforcement of Canadian legislation, and the response to dangerous goods incidents on the highways. Traditional vehicle accident reporting methods do not necessarily reflect the true cause of an incident, and an analysis of the incidents occurring in the province during 1991 was done to assess the human error factor in dangerous goods spills in the province. Much of the analysis is based on post accident investigation, but there appears to be sufficient data to point to human error, opposed to mechanical failure, as a significant factor in dangerous goods incidents. Industry response to suggestions for improvements has been positive, and has reduced the incident frequency in some areas.

Cause	1st Q	2nd Q	3rd Q	4th Q	Total	%
Environment	3	2	1	7	13	7.2
Human Factor	23	18	27	18	86	47.5
Insecure	5	4	4	1	14	7.7
Equip. Failure	13	10	8	8	39	21.5
Unknown	3	6	8	6	23	12.7
Vandals	1	0	0	0	1	0.6
Packaging	0	2	1	0	3	1.7
Other	0	0	2	0	2	1.1
Total	48	42	51	40	181	100

(From Hammond & Smith - Table 3 "Causes")

Uncertainty Analysis:

For Toxic Cloud Releases:

The US-EPA RMP rule analysis for toxic releases points out several uncertainties to consider for a release. The use of the look up tables or models for gas releases (to determine the "endpoint" of the cloud) are based on empirical formulas with little to no considerations for the following:

1. The topic of "dry deposition" is very much dependent on where the release might happen. This is the actual reaction of sulphur dioxide with vegetation, moisture and surfaces as the cloud travels downwind. This mechanism depletes the vapour cloud and as a result the predicted distance it will travel. For the Meadows Development this is a factor in the railway right of way and any buffer zone created by the development layout.
2. "Puff" releases. Again the model for a release over a time frame of 10 minutes depicts a continuous "sausage like" cloud and that cloud continues in that basic shape downwind as it dilutes with the surrounding air all the way to the calculated endpoint. It turns out that as the cloud drifts downwind it

changes due to topography and winds to look more like a series of puffs. A puff traveling downwind sees turbulence, which causes it to lengthen and grow in width and height, which makes the dilution process happen quicker. The result is the predicted downwind distance to the "end point" is actually shorter.

3. Weather conditions are usually fairly consistent in our part of the world however they do change. It may be a small concern but particularly for larger incidents a cloud will form and take several hours of travel before it reaches its endpoint. A toxic leak would need to travel some 25 km to the endpoint. However if these clouds travel slowly (1.5 metres/sec.) it could take up to 10 minutes to travel 1 km and 4½ hours to reach the endpoint. By that time weather conditions are likely to change some or a lot.
4. Pooling of the heavy vapour cloud (which depicts all the clouds formed by the chemicals noted here including flammable materials) in very low to no wind conditions can happen. That is to say the cloud will "sit there" and "slump" becoming very large in area and little depth (only a few inches).
5. Time varying exposure at the endpoint may vary if people are only in the area for less than one hour, which is used as the standard exposure time. If one is only exposed for a few minutes the consequence is less than being exposed for one hour. It is pointed out that an individual can be exposed to higher concentrations for shorter periods.

All the issues discussed above would reduce the predicted distances to the exposure endpoints. This gives confidence that the numbers discussed are good guidance as they will be on the conservative side.

Human Reliability Analysis:

Human involvement has proven to be often at the root of the causes for incidents. And these causes are shown to be management failings for the most part. To do a thorough analysis would be something that may be useful if the overall scope of the project is to reduce the probabilities. For now the human factor is included in the data used it just has not been differentiated from other causes. Suffice it to say management systems focused on people and people's actions is important.

Please note the statistics from Alberta Transportation showed 47.5% of highway incidents have some human factor component involved. Also note the data from the Center for Chemical Process Safety in the US shows a significant incident as a result of operator error will happen once every 28 years.

Conclusions:

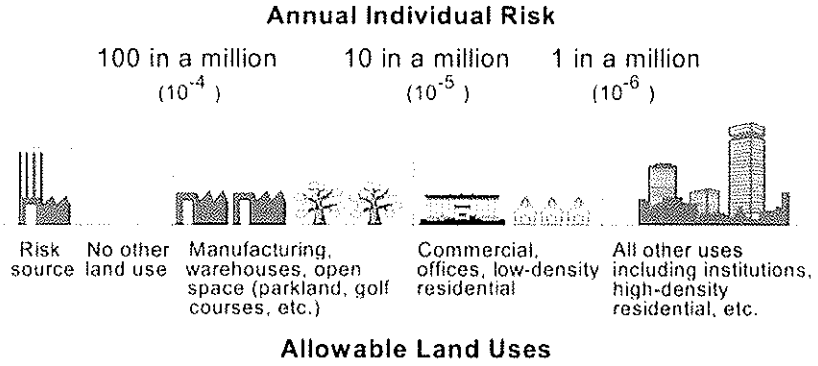
The probability of an incident where a release of any of the hazardous chemicals identified in this report is to be considered carefully. The data around operational incidents indicates a possible probability of 7.5×10^{-5} down to 7.5×10^{-5} is possible. I see this as a conservative value. It also is within acceptable limits as discussed in the next appendix.

Appendix "7"

Risk Analysis

- Acceptable Level of Risk Criteria (MIACC)
- Individual Risk
- Societal Risk

Acceptable Level of Risk Criteria (MIACC):



The MIACC Risk Acceptability Criteria describes the level of risk for a member of the public who is inadvertently exposed to an industrial incident must be better than a 1×10^{-6} chance of a fatality. However as the risk contour moves towards the source of the risk the risk level increases understandably. But note that this risk cannot be higher than 1×10^{-4} of a fatality. With this in mind special focus on the workplace is needed to further lessen the exposure potential for workers.

This acceptable risk criteria is Canada's approach to a global consensus around industrial risks and land use planning. The concept is developed from a legal conclusion that from a public point of view it is acceptable to have an individual exposed to one chance in a million of being fataly injured over a one year time frame. With this information through the consensus organization called the Major Industrial Accidents Council of Canada the above criteria was agreed on.

The type of activity along with the exposure level and density of people all play a part in the determination of the acceptable level for Canada. This is completely in line with the rest of the industrial world.

Risk:
Risk is the combination of consequence and probability. It is often referred to as

"Risk = Consequence X Probability"

The consequences of concern are:

- Exposure to sulphur dioxide, which can be fatal.

The probability of such incidents can be in the order of:

- $7.5 \text{ X } 10^{-5}$ to $7.5 \text{ X } 10^{-6}$.

We also refer to risk as "Individual versus Societal" and "Voluntary versus Involuntary". The acceptable risk criteria shown above, is for Involuntary /Individual risk. That is to say the risk an industry imposes on an individual. This becomes the measure.

When discussing societal risk the result is a lot less clear. Here we are imposing an industrial risk on more than one person and in the eye of the public it is not as easily accepted. A residential community such as planned here, means there will be many people in the area that could be affected by fire or a toxic cloud. The calculations for societal risk (expressed as the frequency of multiple casualty events) are different but they can be expressed in a similar way, that being the likelihood of multiple fatalities at one location is a type of societal risk measure. Because the probability and risk of an event is well below the MIACC Acceptable Level of Risk Criteria it was felt the societal risk could be discussed this way. The incidents that could result in multiple casualties are the toxic cloud release. These combined with the availability for people to shelter indoors and an emergency response plan again further reduce the probability of casualties well below what is considered acceptable in Canada today

This review is about the impact of the identified scenarios on a population in the area of the plant site as defined by the worst-case scenario. The possibility that many peoples will be impacted by sulphur dioxide needs to be determined by the quantity of sulphur that could be in a fire. Again looking at the consequence analysis 1,400 Kg or more would impact downwind 5 Km.

Presumably the site is manned 24 hours per day with detection systems and enough water to mitigate a possible fire to the process area, pastille pile and loading area. Making the risk in the acceptable region.

Appendix "8"

Conclusions & Recommendations

Discussion of Results:

1. The probability of an incident happening is not low compared to the acceptable level of risk identified by the MIACC work. However it is conservative. The numbers of people offsite affected by a toxic cloud are low. The consequences are known and although they may expose members of the public the reaction to an incident itself could effectively handle most of the situation. However, not everyone will be notified and exposures will happen.

2. Potential for dust collections and leaks from tanks, hoses, pipes and equipment are areas of focus. The company will need to put a high priority on this because of the potential for impacting the communities. More inspection, testing and maintenance activity than what would be considered to be normal is an area of focus.

3. The analysis tries to point out the quantity of sulphur needed to impact residents. Knowing this value and developing the plant design for storage, operations and fire protection features to adequately contain the worst-cases is suggested.

Appendix "9"

References

References:

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Attachment 8: AST & Community Committee Meeting Minutes

Attachment 8

Summary of the development of the AST & Community Committee and an overview of key discussions

Public Consultation

138 Volume IID, Section 5.6.6, Pages 5-23, Appendix VI

a) Provide meeting minutes for AST & Community Committee meetings held subsequent to June 7, 2007.

1. Background on the Development of the AST & Community Committee

During the one-on-one interviews and phone calls conducted between September and December 2006, stakeholders were asked how they would like to be consulted in the future. In addition to probing stakeholder interest on a variety of traditional consultation approaches such as open houses, newsletters and one-on-one meetings, the idea of forming a locally-based committee to enhance communication on the proposed Project EIA process was presented. There was considerable stakeholder interest in exploring this idea and as such, follow-up calls were made to interested parties as well as to any other potentially interested parties identified by the consultant team. Interested parties were polled for the most convenient date, time and location for this initial meeting to take place. Four possible meeting dates were offered to stakeholders.

In addition, information about forming a locally-based committee and an invitation to participate was also in the December 2007 Newsletter.

2. January 31, 2007 AST / Community EIA Consultation Committee

Drawing on past experience in facilitating these types of groups in other Alberta communities, the Facilitation Team (RMC & Associates) developed a proposed mandate and structure document for stakeholder consideration. This document, along with a proposed agenda, was sent to interested parties in advance of the meeting.

Facilitated by Rob McManus and Susan Davis Schuetz (from RMC & Associates), the first AST/Community EIA Consultation Committee meeting was held the evening of January 31, 2007 at the Lamont Recreation Centre.

Rob Mann and Sylvia Holowach from HASCO/AST and Gord Johnson from WorleyParsons Komex attended. Approximately 35 stakeholders attended. In addition, a number of individuals expressed interest in coming to the meeting but were not able to attend due to a prior commitment.

Rob McManus and Susan Davis Schuetz facilitated a dialogue with meeting participants on ideas around preferred communication and consultation processes. The following is a summary of meeting outcomes:

- Rob McManus discussed the collaborative process, including some of the opportunities and challenges there are with these types of processes
- the majority of meeting participants expressed an interest in forming a committee
- the possible aims and structure of the committee were discussed
- feedback on the level of interest in forming some sort of locally-based committee was provided verbally by participants near the end of the meeting and through completed feedback forms
- as anticipated, a number of questions regarding the EIA regulatory process arose. RMC and Associates had discussed this possibility with both AENV and the NRCB who both offered to

present a regulatory process workshop if there was stakeholder interest. Rob McManus extended this offer and meeting participants asked for the workshop.

The following "go-forward" actions have been taken as follow-up to the AST/Community EIA Consultation Committee meeting.

- a follow-up letter was sent to AENV and copied to the NRCB expressing stakeholder interest in attending a regulatory process workshop to improve their understanding of the regulatory process for the local community;
- the Newsletter – Volume II – March 2007 was mailed in early March 2007 to all stakeholders. This newsletter contained the following:
    - an update on the EIA public consultation activities to date
    - description of the community meeting held on January 31st, 2007 at the Lamont Recreation Center to discuss forming a community consultation committee
    - update on the current status of the EIA
- A mail-out package containing: the Newsletter – Volume II – March 2007, the Draft January 31, 2007 AST/Community EIA Consultation Committee meeting notes, and a copy of the follow-up letter to AENV (and copied to the NRCB) was sent to the following:
    - January 31, 2007 AST/Community EIA Consultation Committee meeting participants
    - stakeholders who had expressed an interest in attending the January 31, 2007 AST/Community EIA Consultation Committee meeting but were unable to attend
    - stakeholders who had indicated they would attend the January 31, 2007 AST/Community EIA Consultation Committee meeting but did not

The Draft January 31, 2007 AST/Community EIA Consultation Committee meeting notes and power point presentation were posted on the website at www.hazco.com.

3. April 3, 2007 Working Group Meeting

In response to January 31 meeting participants' interest, Rob McManus and Susan Davis Schuetz (Facilitation Team - RMC & Associates) assisted in facilitating the proposed project's consultation program and contacted all those that verbally or in writing expressed an interest in forming and participating in a locally-based committee. The purpose of contacting these stakeholders was to gather feedback on what a committee mandate and structure should be. Stakeholders were probed on a convenient date, time and location for this second meeting which resulted in the April 3, 2007 meeting date.

In advance of the April 3, 2007 meeting, RMC & Associates developed a proposed agenda and a proposed meeting work plan and sent these documents to all invitees either by email, fax or in person. The purpose of the proposed work plan was to provide background information on the different committee element options.

The meeting was held April 3, 2007 in evening in Lamont at the Curling Rink Lounge. It was facilitated by Rob McManus and Susan Davis Schuetz (RMC & Associates). There were fourteen meeting participants: 12 community[1] members from the Lamont and Bruderheim areas and 2 AST representatives (Rob Mann and Sylvia Holowach). Three community members from the Lamont and Bruderheim areas were absent with regrets.

[1] Community is used in the broadest sense and includes industrial neighbors, elected officials, members of the Friends of Lamont County, residents within 1.5 km of proposed facility, residents beyond 1.5 km of proposed facility, etc.

Meeting participants provided feedback and advice on the following:

- Principles used to guide meeting discussions
- Ground rules to create a framework for constructive dialogue
- Proposed committee mandate, structure and processes:
    - committee size
    - other stakeholder 'group' participants
    - committee member roles and responsibilities
    - decision-making method
    - frequency of meetings
    - process to provide committee information to broader community
    - meeting minutes development
    - the role of media in meetings
    - meeting location

April 3, 2007 meeting participants recommended the establishment of a committee for the purpose of:

- enhancing communication through the sharing of credible information - clarify questions about the proposed project and find effective ways to share information
- problem-solving / issue resolving when these opportunities present themselves; and
- building more positive, go-forward relationships amongst all.

Meeting participants collectively identified April 25, 2007 as the date for the next meeting. However, due to a conflict with the Lamont County, Municipal Development Plan & Land Use Bylaw Review Public Meeting subsequently scheduled on the same evening, the committee meeting date was collectively moved to May, 3 2007.

The following "go-forward" actions have been taken as follow-up to the April 3, 2007 Working Group Meeting:

- DRAFT April 3, 2007 Working Group Meeting notes were developed and sent to meeting participants for review
- An invitation to the May 3, 2007 meeting was offered to representatives from the additional stakeholder 'groups' identified by April 3, 2007 meeting participants
- A proposed agenda for the upcoming May 3, 2007 meeting was developed and sent to all April 3 meeting participants as well as representatives from other stakeholder 'groups' identified by April 3 meeting participants for review
- A proposed work plan for the upcoming May 3, 2007 meeting was developed and sent to all April 3 meeting participants as well as representatives from other stakeholder 'groups' identified by April 3 meeting participants with a request for comment by April 27, 2007.

4. May 3, 2007 AST & Community Committee Meeting

As follow-up to the April 3, 2007 meeting, RMC & Associates developed a proposed May 3, 2007 agenda and work plan and sent these documents by email, fax or in person to the following:

- April 3, 2007 meeting participants;
- those absent with regrets from the April 3, 2007 meeting; and
- representatives of the additional stakeholder groups identified by April 3 meeting participants

The purpose of the proposed work plan was to try and determine what questions, issues or concerns the committee would address first. Since all questions cannot be answered at the same time the Facilitation Team attempted to get feedback from the committee on where we should start. The priority setting process was about sequencing or ordering questions to address community information needs and was not about limiting the number of issues or questions to be addressed.

The meeting was held the evening of May 3, 2007 in Bruderheim at the Bruderheim Boardroom. It was facilitated by Rob McManus and Susan Davis Schuetz (RMC & Associates). There were fourteen meeting participants: 12 community members from the Lamont and Bruderheim areas and 2 AST representatives (Rob Mann and Sylvia Holowach). Six community members from the Lamont and Bruderheim areas were absent with regrets.

The following is a summary of meeting outcomes:

- AST & Community Committee was formally adopted as the committee's name
- Committee members revised their mandate to the following;
    - enhance communication through the sharing of credible information - clarify questions about the proposed project and find effective ways to share information *to create a more informed dialogue in the community*;
    - problem-solve / issue resolve when these opportunities present themselves; and
    - build more positive, go-forward relationships amongst all.
- The principle of transparency among committee members and with the broader communities was discussed and additional processes were put into place to achieve transparency
- The Facilitation Team provided a summary of the proposed facility site questions, issues and concerns from those residing within 1.5 km of the site as well as a summary of the facility site questions, issues and concerns of those residing beyond 1.5 km of the site. The summary was structured according to the number of stakeholders that raised a particular question, issue or concern. After reviewing these summaries, committee members decided that their initial focus would be on the following (in order):
    - Air
    - Water
    - Health
    - Emergency Response
    - Vehicle and Rail Traffic
    - Soil
    - Property Values
- Committee members agreed to the following upcoming committee meeting dates:
    - Thursday evening, June 7, 2007
    - Thursday evening, July 5, 2007
    - Thursday evening, August 2, 2007

- Committee members requested that the Facilitation Team draft a series of key questions around air issues that would form a work plan for review at the next committee meeting.
- Committee members requested that the Facilitation Team develop a letter of invitation and send this invitation letter on behalf of the committee to representatives from the two additional stakeholder 'groups' identified.

The following "go-forward" actions were taken as follow-up to the May 3, 2007 AST & Community Committee Meeting:

- DRAFT May 3, 2007 AST & Community Committee meeting notes were developed and sent to committee members for review
- An invitation to the next AST & Community Committee meeting (June 7, 2007) was extended by the Facilitation Team by letter on behalf of the committee to representatives from two additional stakeholder 'groups' identified during the May 3, 2007 meeting.
- A proposed agenda for the upcoming June 7, 2007 meeting was developed and sent to committee members as well as representatives from the two additional stakeholder 'groups' identified for review.
- The proposed work plan for the upcoming June 7, 2007 meeting was developed and sent to committee members as well as representatives from the two additional stakeholder 'groups' identified for review. The Facilitation Team proposed a series of key questions around air issues that would form a work plan for review at the next committee meeting.

5. AST & Community Committee: June 7, 2007 Meeting

As follow-up to the May 3 meeting, RMC & Associates (RMC) sent a proposed agenda and work plan (air related) for the next meeting on June 7 by email, fax or in person to the following people:

- May 3, 2007 meeting participants; and
- those absent with regrets from the May 3, 2007 meeting.

The June 7, 2007 meeting was held in Lamont and was facilitated by RMC. There were 13 meeting participants: 10 community members from the Lamont and Bruderheim areas, 2 AST representatives and one WorleyParsons Komex representative. Eight community members from the Lamont and Bruderheim areas were absent with regrets.

The purpose of the meeting was to review and finalize the proposed air-related work plan and to identify the best process and/or forum to get air-related information out to the broader community.

The following is a summary of meeting outcomes:

- Gord Johnson from WorleyParsons Komex presented the process that was used to assess air quality as well as a high-level summary of study results. The following is a summary of what was presented and subsequently discussed:
    - Air Quality Issues
        - Emission of criteria pollutants
        - Acidification caused by sulphur deposition
        - Emissions related to a sulphur fire
    - Review of criteria pollutants
    - Background air quality - Fort Air Partnership
    - Air Emissions relative to Ambient Air Quality
    - Emissions Sources

- Results of Air Emissions Modeling
- Special Considerations
  - adjacent chlorate plant
  - worst case scenario
  - public and worker health, livestock
  - impacts to water and soil quality

- Gord Johnson offered to develop a summary of the key areas of air quality for committee members. It was suggested that this summary could assist committee members in deciding what would be the best process and/or forum to share this information with the broader community. Committee members agreed a summary would be helpful and accepted this offer.
- Committee members re-confirmed the following upcoming meeting dates:
  - Thursday evening, July 5, 2007
  - Thursday evening, August 2, 2007

The following go-forward actions were taken as follow-up to the June 7 meeting.

- DRAFT June 7, 2007 AST & Community Committee meeting notes were developed and sent to committee members for review along with the WorleyParsons Komex power point presentation on air quality.
- A proposed agenda for the upcoming July 5 meeting was developed and sent in advance of the July 5 meeting to committee members for review
- WorleyParsons Komex developed a summary of the key areas of air quality and RMC sent this summary to committee members in advance of the upcoming July 5 meeting for review.
- AST developed the AST Safety Provisions Summary in preparation to provide to committee members at the July 5 meeting.
- WorleyParsons Komex developed a presentation in preparation of the July 5 meeting illustrating the process that is used to assess stakeholders' remaining priority issues (soil, water, vehicle and rail traffic, property values).
- RMC re-contacted the Fire Chief of Lamont and extended an invitation on behalf of the committee members to participate in the process. This individual accepted the invitation.

6. AST & Community Committee: July 5, 2007 Meeting

As follow-up to the June 7 meeting, the Facilitation Team sent a proposed agenda and both the Air Emissions Control Measures and Responses documents by email, fax or in person to the following people:

- June 7, 2007 meeting participants;
- those absent with regrets from the June 7, 2007 meeting; and
- two stakeholders interested in participating in this process.

The July 5, 2007 meeting was held in Lamont at the Lamont Recreation Centre and was facilitated by RMC. There were 13 meeting participants: 10 community members from the Lamont and Bruderheim areas including two new community members, 2 AST representatives and one WorleyParsons Komex representative. Eight community members from the Lamont and Bruderheim areas were absent with regrets.

The purpose of the meeting was to:

- follow-up on June 7 meeting air-related presentation and decide what would be the best process and/or forum to get air-related information out to broader community members;
- present information on processes used to study remaining community priority issues; and
- identify what would be the best process and/or forum to get information on the remaining priority issues out to broader community members.

The following is a summary of meeting outcomes:

- Rob Mann distributed the HAZCO/AST *Facility Designed Basic Safety Provisions* handout to meeting participants as follow-up to a committee member June 7 request.
    - A question and answer period followed the review of the HAZCO/AST *Facility Designed Basic Safety Provisions* document
- Gord Johnson from WorleyParsons Komex provided the responses to June 7 unanswered questions. He also provided additional information on air emission controls and measures as per committee members' request. Finally Gord Johnson presented the process that is used to assess the community priority issues as well as a high-level summary of study results. The following is a summary of what was presented and subsequently discussed:
    - Review of air-related responses to questions
        - A question and answer period followed the review of air-related responses to questions
    - Overview – air emissions controls and monitoring
        - A question and answer period followed the overview of the air emissions controls and monitoring
    - Other Priority Issues to be addressed
        - Water
        - Health
        - Emergency Response
        - Traffic – Vehicles and Rail
        - Soil
        - Property Values
- A subcommittee was formed comprising of 2 community committee members, 2 AST representatives and 1 member from the Facilitation Team for the purposes of developing a proposed information sharing plan which will be presented at the September 13 meeting for consideration.
- Committee members confirmed the following upcoming meeting dates:
        - Thursday evening, September 13, 2007
        - Thursday evening, October 4, 2007

The following go-forward actions were taken as follow-up to the July 5 meeting.

- DRAFT July 5, 2007 AST & Community Committee meeting notes were developed and sent to committee members for review along with the WorleyParsons Komex power point presentation on the remaining priority issues.

- A proposed agenda for the September 13 meeting was developed and sent in advance of the meeting to committee members for review
- The subcommittee developed an information sharing plan prior to the September 13 meeting and presented it to committee members for review.

7. Subcommittee, AST & Community Committee: late July and August 2007 activities

During the July 5 AST & Community Committee meeting, committee members agreed that a Subcommittee be formed for the purpose of developing a proposed information sharing plan. It was further agreed that the Subcommittee present their proposed information sharing plan to the broader committee members for review at the next AST & Community Committee meeting which was scheduled for September 13, 2007.

The Subcommittee was comprised of two community representatives, two AST representatives and one (RMC) representative.

The Subcommittee undertook the following activities to develop a proposed information sharing plan:

- Two conference calls to develop and finalize a proposed information sharing plan;
- Numerous e-mail communications and telephone calls to finalize a proposed information sharing plan; and
- Involvement of broader committee members to review proposed information sharing plan.

8. AST & Community Committee: September 13, 2007 Meeting

As follow-up to the July 5 meeting, the Facilitation Team sent a proposed agenda by email, fax or in person to the following people:

- July 5, 2007 meeting participants; and
- those committee members absent with regrets from the July 5, 2007 meeting.

The September 13, 2007 meeting was held in Lamont at the Lamont Recreation Centre and was facilitated by RMC. There were 8 meeting participants: 5 community members from the Lamont and Bruderheim areas, 2 AST representatives and one RMC representative. Lower attendance was expected due to a number of committee members' previous commitments but there was agreement that a meeting needed to be held to finalize an information sharing plan around the Environmental Impact Assessment (EIA).

The purpose of the meeting was to:

- present the Subcommittee's proposed information sharing plan;
- obtain committee member feedback on the proposed information sharing plan; and
- finalize the information sharing plan.

The following is a summary of meeting outcomes.

- The Subcommittee presented their proposed information sharing plan and through meeting discussions, this plan was finalized with minor modifications.

- It was agreed that the *Environmental Impact Assessment Information Forum: Proposed Bruderheim Sulphur Forming & Shipping Facility* event would take place at the Lamont Recreation Centre, October 11, 2007 from 3:00 p.m. - 9:00 p.m.
- Committee members confirmed the next AST & Community Committee meeting date to be Thursday, November 1, 2007 starting at 6:30 p.m. with the location to be determined.

The following go-forward actions were taken as follow-up to the September 13 meeting.

- Coordination of the *Environmental Impact Assessment Information Forum: Proposed Bruderheim Area Sulphur Forming & Shipping Facility* event. This included, but was not restricted to, finalizing location, advertising the event through newspaper ads, invitation letters, HAZCO website and other possible venues, confirming regulator attendance, preparing presentations, etc.

- Inquired about the October 22, 2007 AENV deadline and provided regulator response to committee members.

- Developed a list of all 'information to be released at a later date' and provided to committee members.

- DRAFT September 13, 2007 AST & Community Committee meeting notes were developed and sent to committee members for review.

- A proposed agenda for the November 1, 2007 meeting was developed and sent in advance of the meeting to committee members for review.

9. October 11, 2007 Environmental Impact Assessment Information Forum

Drawing on feedback received from area residents and other interested parties through the AST & Community Committee process, HAZCO/AST held an Environmental Impact Assessment Information Forum (hereafter referred to as the Forum) on Thursday, October 11, 2007 at the Lamont Recreation Center from 3:00 p.m. to 9:00 p.m.

AST & Community Committee members made a number of recommendations regarding Forum advertising, timing, structure, information and follow-up that were adopted by AST. These recommendations included, but were not restricted to the following:

- Forum advertising:
    - advertise in newspapers prior to the Forum;
    - post Forum program on HAZCO website; and
    - mail invitation letter along with Forum program to all parties that had expressed an interest in the proposed project.
- Forum timing:
    - hold the Forum prior to October 22; and
    - hold the Forum during the week - afternoon/evening preferred.
- Forum structure:
    - have a session describing the Proposed Bruderheim Sulphur Forming & Shipping Facility Project;

    - have a presentation outlining the roles of Alberta Environment and the Natural Resources Conservation Board;
    - have informal discussion opportunities for those interested in one-on-one discussions;
    - have professionals who conducted the Air, Water & Soil, Safety & Emergency Response and Health studies be the individuals that present the purpose and results of these studies to Forum attendees; and
    - have participant break-out workshop sessions relating to Air, Water & Soil, Safety & Emergency Response and Health
- Forum information:
    - have hard copies of the presenter power point presentations available for attendees;
    - have hard copies of presenter biographies available for attendees;
    - have information on Alberta Environment (AENV) and Natural Resources Conservation Board (NRCB) processes available for attendees; and
    - have high-level summaries in the form of 1 to 2 page handouts available for attendees.
- Forum follow-up:
    - document all attendee questions and presenter responses; and
    - post these questions and answers on HAZCO website once all are consolidated.

HAZCO/AST advertising for the Forum included the following:

- running an announcement in the Lamont Leader October 2 and October 9 respectively;
- running an announcement in the Red Water Review October 2 and October 9 respectively;
- mailing invitation letters and the Forum program on September 28 to all those who had expressed interest in the proposed project which resulted in approximately 300 invitations being mailed; and
- posting the Forum invitation letter and program on the HAZCO website.

As noted above, the Forum was held on Thursday, October 11, 2007 at the Lamont Recreation Center from 3:00 p.m. to 9:00 p.m. Approximately 25 area residents attended the event along with representatives from AENV and the NRCB. The event commenced with a welcome and introductions followed by a presentation by representatives from Alberta Environment and the Natural Resources Conservation Board, Forum objectives and an overview of the proposed project. Forum attendees were then provided the opportunity to participate in a break-out session (Air, Water & Soil, Health or Safety & Emergency Response) of their choosing. Each break-out session was held four times over the course of the afternoon and evening thereby allowing attendees interested, an opportunity to participate in all four break-out session topics.

Each break-out session followed the same format: a presentation of the study conducted and the subsequent results and then a question and answer period. Attendee questions asked and presenter responses provided were documented by RMC as well as HAZCO/ AST representatives so that the questions and their responses could be consolidated into one document and made available to the public through the HAZCO website as well as hard copy hand out to those interested. Hard copies of the presentations as well as summary handouts were also made available for those attendees wishing copies.

Given the high level of community member interest, a session providing an overview of both AENV and NRCB processes was provided. Written materials on these regulatory processes were prepared by both AENV and NRCB and made available to interested attendees.

Finally, Forum participants were provided an opportunity to share their feedback on the event as well as ask any additional questions they may have had by completing a Comment Form.

The following Forum follow-up steps have and/or will be taken:

- posting of presenter presentations on HAZCO website;
- posting of presenter 1-2 page handouts on HAZCO website;
- posting presenter biographies on HAZCO website;
- mailing of various documents to Forum attendees as requested;
- responding to questions noted on comment forms; and
- consolidating attendee questions and presenter responses and posting these on the HAZCO website.

10. AST & Community Committee: Next Steps

A part of the mandate of the AST & Community Committee is to "*enhance communication through the sharing of credible information – clarify questions about the proposed project and find effective ways to share information to create a more informed dialogue in the community".* Over the past several months, committee participants provided valuable advice on how best to share information about the proposed project and the EIA with the broader community members. This advice resulted in the creation of the Environmental Impact Assessment Information Forum.

Following this event, RMC determined that it was an appropriate time to review what the committee's next steps should be with its members. As such, a survey was sent to committee members October 23, 2007. Included in this survey was a request to share their preferred next meeting date.

Based on committee member feedback, the next AST & Community Committee meeting was scheduled for Tuesday, December 4, 2007. However, due to anticipated bad weather conditions as well as changes in committee members' availability, the Facilitation Team cancelled this meeting. Committee members were polled mid-to late December 2007 for their availability to meet in January 2008. Results of this polling identified Thursday, January 24, 2008 as the most convenient time for committee members to meet. As such, the next scheduled AST & Community Committee meeting was set for this date. The primary purpose of the meeting was to collectively determine what the committee's next steps should be.

11. AST & Community Committee Meeting: January 24, 2008

The Facilitation Team sent a proposed agenda to all committee members by fax, e-mail or in person in both late December 2007 and early January 2008.

The January 24, 2008 meeting was held in Lamont at the Lamont Board Room and was facilitated by RMC. There were 12 meeting participants: 8 community members from the Lamont and Bruderheim areas, 2 AST representatives and 2 RMC representatives. The purpose of the meeting was to collectively determine what the committee's next steps would be.

The following is a summary of meeting outcomes as understood by HAZCO/AST as meeting notes have yet to be reviewed and adopted by committee members.

- Meeting participants collectively agreed to the following go-forward focus for the AST & Community Committee:

- Identifying outstanding issues and concerns and seek to address them where possible
- Explore the synergy group model as something the committee might transition to in the future
- Extend invitations to participate in the committee process to those newly elected or assigned (i.e. Lamont County, Town of Bruderheim, Triton) as well as other community members.

b) In AST's opinion, are all the significant stakeholders, as identified in Appendix VI (see pages 2 and 3 of the Committee Mandate and Structure Development Worksheet prepared by RMC & Associates dated April 3, 2007), represented on the AST & Community Committee? If not, which stakeholders are not represented? Are there any significant stakeholders that have chosen not to work with the AST & Community Committee?

The following table illustrates the stakeholder groups identified in the *Committee Mandate and Structure Development Worksheet* that are and are not represented on the AST & Community Committee.

Stakeholder Group	Represented on AST & Community Committee	Not represented on AST & Community Committee
Residents that reside within 1.5 km of the proposed facility site	✓	
Community members at large (beyond 1.5 km)	✓	
Town of Lamont elected officials or administrators	✓	
Town of Mundare elected officials or administrators	✓	
Town of Bruderheim elected officials or administrators		x
Friends of Lamont County	✓	
Lamont County	✓	
Emergency Response & Safety (Bruderheim and Lamont Fire Chiefs)	✓	
Local industry	✓	
Parent Advisory Committee		x
Lamont Health Care Centre		x
Fort Saskatchewan Air Partnership		x
Northeast Region Community Awareness & Emergency Response (NRCARE)	✓ NRCARE member represented on committee	
NorthEast Capital Industrial Association (NECIA)	✓ NECIA member represented on committee	
Elk Island Public Schools		x
Family & Community Services	✓ Represented by Lamont County	
Friends of Elk Island		x
Alberta Industrial Heartland		x
Alberta Environment and/or Natural Resources Conservation Board		x
AST/HAZCO	✓	
WorleyParsons Komex	✓	

Operating on the principle of inclusivity as well as the belief that stakeholders self-define whether they are an interested party or not, both HAZCO/AST and the Facilitation Team (RMC & Associates) developed this list of potentially interested parties. The Committee's membership was subsequently reviewed with local stakeholders to gather their views on other potential parties. None were identified through this process.

As demonstrated in the Consultation Report and in the Two Month Updates on Consultation Activities submitted to Alberta Environment, contact was made either in person or by phone with a representative

from each stakeholder group. All were invited and provided the opportunity to participate in the AST & Community Committee process. Meeting dates were identified through a community member polling process in an effort to eliminate scheduling conflicts.

To accommodate those that were invited to participate in the AST & Community Committee process but have not participated, HAZCO/AST provided a number of other consultation methods such as an Open House, one-on-one visits, telephone communication, offers to meet in person sent by letter, Newsletter Volume I, Newsletter Volume II and the Environmental Impact Assessment Information Forum as well as a local information office in Town of Lamont

Finally, the AST & Community Committee remains open to new members and interests should these be identified or expressed by other organizations or persons.