DEC's comments/recommendations on: United States Geological Survey (USGS) Comments (dated 8 July 2005) on the Draft DMTS Fugitive Dust Risk Assessment Prepared by Exponent for Teck Cominco Alaska Incorporated (dated April 2005).

No.	Comment	Priority	Recommendation
USGS-1, -2	***1. Was the risk assessment unbiased and based on good science? What are the shortcomings?*** The risk assessment appears to be based upon valid science and follows best practices for evaluating ecological risk, relying heavily on site-specific and selected published data. This risk assessment is based on specific regulatory guidance that does not necessarily generate information that is of specific significance to the unique ecology of the CAKR. For example, extrapolation from benchmark data from unrelated species to organisms unique to this arctic habitat may introduce inaccuracies not fully anticipated by regulatory guidance. In addition, regulatory guidance can lead to a narrowly focused assessment that may include data gaps and introduce uncertainty and bias to resource management plans developed for Park Service lands. For example, the most sensitive receptors may not be the charismatic higher-order receptors that normally receive regulatory attention. Standard benchmark criteria may also introduce uncertainties and bias. For example, it may be misleading to assume that median values for accumulation factors for certain metals in biota are conservative in comparison to metal concentrations in sediment or soil. Also, in following regulatory guidance, some components of the ecosystem, such as soils, soil dwelling invertebrates, mosses and fungi, are primarily considered to be sources of contamination in the food chain rather than as receptors of contaminant impact. From an ecological perspective, soils and associated vegetation communities may be the most sensitive receptors in the system at risk, especially within the context of long-term sustainability. While food chain analysis is commonly used by regulators, reliance on a generalized food-chain analysis for characterizing risks may not adequately consider other potentially more critical receptors (e.g., soil biota and vegetation) in the unique tundra systems. Concerns of the Park Service for managing their resources may not be considered in regulatory approaches, since these do not adequately forecast risks nor provide sufficient foundation for addressing long-term resource management needs. Furthermore, *Exponent's* assessment of risks to mammals that frequent the haul road region is based on assumptions about metals accumulation in the food web that may be unrealistic for this ecosystem. Their assessment includes no biological measures of sub-lethal chronic effects in higher-level organisms, nor consideration of cumulative impacts of all metals to which the organisms are potentially exposed.	High	Please provide response regarding how soil invertebrates, mosses, and fungi (i.e., lichens) were handled in the ecological risk assessment (ERA). Please provide response to criticism that sub-lethal chronic effects and cumulative impacts were not assessed Please respond to other criticisms of the overall ERA approach as warranted.

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USGS-3	***3. What is most at risk and what are the risk levels?*** The ecosystem factors most at risk of injury are the organisms unique to the arctic tundra for which there are limited information regarding body burdens of metals or their toxicological significance. Representative species considered as part of the food-chain analysis may not be adequate to predict exposure to the wide range of species which may be of interest to the Park Service. For example, tundra vegetation and invertebrates are undervalued in the RA, and are primarily evaluated as a derivative source of contamination. In reality, these components of the tundra ecosystem are also receptors of the contamination. Limited benchmark data for these species also increases uncertainty with any characterization of risk. Adverse effects in soil and vegetation communities are inadequately considered because benchmarks might not be relevant to those of tundra soils.	Medium	Please respond regarding the level of evaluation (and value) given to tundra vegetation and invertebrates. Please respond to comments on available benchmarks and resulting uncertainty. Ensure that this issue is adequately discussed in the uncertainty section of the revised ERA.
USGS-4	***4. Future research focus*** It is critical to develop monitoring plans amenable to long term management goals envisioned by the Park Service. This includes selection of relevant biota and endpoints as well as appropriate temporal and spatial sampling plans. This monitoring would also be useful in evaluating the success of dust management efforts. Biomarker and other measures of sublethal impacts may provide weight-of-evidence information about receptors and pathways and "ground truth" the findings of risk assessments because sub-lethal chronic effects are difficult to predict from COPC analysis and risk assessment modeling exercises. Within the context of developing monitoring plans amenable to long term management goals envisioned by the Park Service, selected biomarkers complementary to those measures of effect could serve as sensitive indicators of effects that may develop through time. The risk management plan should focus on those components of the system at risk by addressing questions related to bioavailability and undervalued resources such as soils and vegetation. In addition, comparison of toxicity and differential bioavailability of ore concentrates versus weathered mineral outcroppings could help differentiate mining inputs from ambient environmental exposures, if studies were designed to address the question. Such studies could also provide insight as to pathways of ore concentrates to biological receptors, and serve to refine exposure models employed in the food-chain analysis captured in the RA.	High	Please provide response regarding the usefulness of implementing the suggested monitoring studies to address the stated concerns. Consider incorporating the suggested studies into future monitoring plans and/or the risk management plan for the site.

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	I. Overview:		
USGS-5	The RA generally concludes that there are no significant impacts to biota associated with the operation of the Red Dog Mine. The process of a standardized regulatory risk assessment compares metals concentrations in soils, sediment, and water, and tissues of plants and animals with toxicity information from existing data bases and regulatory criterion concentrations. Assimilation of metals from dietary and environmental pathways is also based on assumptions on dietary assimilation and area use. Numerous assumptions, consistent with these standardized procedures were made to reach conclusions regarding bioavailability, uptake and toxicity of metals to various organisms in areas adjacent to mine operations. Certain conclusions are made without sufficient supporting documentation. For example: 1. Conclusions about confounding impacts of metals and dust on plant communities reflect limited sampling and information about soil quality. 2. Conclusions as to the lack of impacts to populations are unsupported even though voles and shrews are clearly exposed. 3. Conclusions about metals concentrations in soils are not supported by information about the soils such as pH, action exchange capacity, total organic carbon, or nutrient levels. 4. Uncertainties were not clearly discussed relative to impacts to the unique arctic ecosystem of the Cape Krusenstern National Monument (CAKR).	High	The ERA should be revised so as not to include the unsupported conclusions listed in this comment.
USGS-6	In summary, the draft risk assessment is well presented but questions remain regarding the ecological relevance of measurement endpoints and receptors to the CAKR ecosystem. Most generally, reliance upon benchmark criteria while sufficient for the regulatory framework of this Risk Assessment may not be sufficiently protective of biota of concern to surrounding resource management agencies.	Medium	Please respond regarding the overall protectiveness (i.e., conservativeness) of the ERA approach and design. Please revise the ERA as necessary to clearly describe weaknesses in the overall approach.
	II. Data gaps and Uncertainties:		
	Metals Toxicity to Resident Biota:		
USGS-7	1. The estimated toxicity of metals to species existing at the mine site, haul road, and port facility are based on published information derived from other species that may be less sensitive or of greater sensitivity than organisms native to site potentially impacted by mine operations. For example, use of bovine data may be more applicable to caribou and muskoxen than rodent data. 2. The benchmark data base used to predict toxicity to endemic organisms does not likely reflect the most sensitive life stage for the target species. 3. The benchmark data base does not consider the potential for impacts to physiological or behavioral functions that might limit essential life functions.	High	Please provide a response to each of the five shortcomings listed under *Metals Toxicity to Resident Biota* and, if possible and necessary, revised the ERA to address them.

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	4. In addition, the toxicity data base does not consider multiple stressor interactions that might occur at the mine site that could additively increase injury to the target species. 5. As per regulatory guidance, cumulative risk estimates should be considered because several chemicals that were eliminated from the listing of contaminants of potential concern (COPC) could be expected to occur. Furthermore, exposures to the metals mixture would likely have additive impacts to the organism, even when the individual metals affect different biochemical pathways.		
	Metals Speciation/ Toxicity and Biological Availability:		
USGS-8	1. The metals data reflect total metals concentrations without regard to the ionic state (or species) of the metal. Metals speciation plays a significant role in biological availability and toxicity of the metal. For example, lead sulfate is more toxic than lead sulfide and *Exponent* acknowledges that oxidation of metals sulfides to metal sulfates is likely to occur. Thus, the environmental chemistry influencing toxicity of metals at the site may not be fully understood.	Medium	Please provide more discussion of metals speciation in the revised ERA, specifically how the uncertainties in this area affect risk estimates and interpretation.
USGS-9	2. The soils of the Arctic are likely to have chemical characteristics quite different from those of soils compiled in the Oak Ridge data base which is used extensively in this RA. Such differences may greatly influence the toxicity and availability of metals in sites adjacent to the Red Dog Mine. The presumed confounding effects of dust versus metals could be resolved if soil characteristics are considered.	Medium	Please provide additional discussion of these issues in the uncertainty section and/or other sections of the ERA as warranted.
USGS-10	3. Conditions might exist at the site to increase (or decrease) the bioavailability of the metals by altering the chemical speciation of the metals. This could be a function of redox potential of the soils/sediment, aerobic/anaerobic conditions, acid-volatile sulfides, ion exchange capacity, humic acids, water quality, and pH. The soil gradient from pH 8 to pH 4 observed over 1000 meters of the haul road could significantly influence speciation and resultant bioavailability of certain metals. There could also be localized chemical characteristics that could alter metals speciation. Humic acids associated with mosses and other vegetation could also concentrate metals for uptake by browsing organisms. Furthermore, ore concentrates are often apparently transported to the port with residues of the flotation chemicals such as xanthates, which themselves are relatively toxic (Xu and others, 1988) and which also may influence the biovailability of the primary COPCs. Although these xanthate flotation chemicals will reportedly decompose in most environments in a few days, which reduces long-term environmental concerns, they have been completely ignored in this RA. The lack of information about the speciation of metals from reference and mining sites might also result in a biased view that the metals from these sites are of comparable availability. Metals in ore concentrates	High	Please provide response regarding the numerous concerns expressed above (e.g. speciation and bioavailability, floatation chemicals, speciation differences between the site and reference areas, etc.) and revise the affected sections of the ERA as warranted.

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	could be more available than those from exposed deposits because of the smaller particle size, the presence of xanthates, and the chemical form of the metal in the ore concentrate.		
USGS-11	4. The bioavailablity of metals incorporated in tissue may likely differ from metals in surface dusts. Biological concentration factors for metals in some plant species can be considerable and may provide a greater input in dietary pathways than food chain pathways would indicate. For example, willows, a food source for ptarmigans, concentrate cadmium. Lichens concentrate metals including lead.	Medium	Please provide adequate discussion of these issues in the revised ERA.
USGS-12	5. The draft RA does little, if any, analysis and characterization of risks as those vary with time. For example, seasonal influences of metals exposure and availability relative to the presence of sensitive organisms or life-stages have not been considered. Season variation in exposure and biological effects may be critical to the evaluation of risks characteristic of early spring snow melt and release of metals loads accumulated on snow-covered ground consequent to winter hauling of ore concentrates. Previous studies by USGS (2004) indicated that metals were accumulated in snow cover across drainages in CAKR. Depending on metal loadings in drainages that occurred over winter, metals potentially already accumulated in aufeis, and the rapidity of snow melt, seasonal releases of metals to soil and to seasonally active streams could lead to exposure and subsequent adverse effects on biota at critical stages in their life history. For example, pulsed exposures to metals could impair (1) seasonal growth of vascular and nonvascular plants, (2) early life stages of plants, including germination, root elongation, and early seedling survival for vascular plants, (3) soil biota, and (4) sensitive larval stages of stream invertebrates or larval insects dependent on ephemeral water bodies.	Medium	Please provide response regarding the seasonal elements of risk identified above and need for additional studies to address them. Discuss this issue in the uncertainty section of the ERA.
	Limited Residue Data:		
USGS-13	1. Assumptions about metal residues in biota were largely based on limited samples of resident biota. Small sample sizes could result in a high degree of variability that may obscure differences in residue concentrations between organisms from exposed and reference sites.	High	Please include in the revised RA a discussion of the trade offs between sample size and statistical power and how it affects site-to-reference comparisons. Clearly indicate any instances where chemicals may have been inappropriately eliminated as COPCs and rectify the problem.
USGS-14	2. Most often tissue residues reflected whole-organism values that might be lower than target organ residue concentrations.	Medium	Please provide response regarding how the lack of residue data for specific organs may limit the value of the ERA. If warranted, discuss this

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			issue in the uncertainty section of the revised ERA.
USGS-15	3. The manner in which a resident population is defined could strongly influence average tissue levels. Musk oxen and caribou limited to the site would likely have higher average tissues levels than organisms sampled from a broader area.	High	Please provide response to this USGS concern, including the need to possibly identify and sample resident caribou and musk ox. Discuss this issue in the uncertainty section of the revised RA. Indicate to what extent human health risks may be underestimated.
USGS-16	4. Metal concentrations in water, soils, and sediments were largely based on limited transects, thus could be variable to the extent that reference and site levels are difficult to differentiate. As mentioned earlier, the speciation of metals could be quite different from one site to the next.	High	Please indicate how this issue effects selection of COPC and conservative evaluation of site risks. Shortcomings in the study design should be clearly described in the revised RA.
USGS-17	5. The sampling of biota and substrates within the CAKR was limited, and information generated by NPS studies was not considered in this RA by *Exponent*, thus estimates on the status of metals contamination to habitat and biota of CAKR are based on very limited data.	High	In the revised RA, please indicate to what extent limited sampling within CAKR may affect the strength of the risk estimates for receptors within CAKR. Please evaluate all available data.
	Uncertainties about Food Pathways:		
USGS-18	1. Assumptions made about the uptake of metals from contaminated food pathways are also a source of uncertainty since such models may not accurately reflect uptake by indigenous biota. It is quite likely that there are species-specific differences in uptake and assimilation of metals based on the literature.	Medium	In the revised ERA, please clearly describe the approach used to evaluate food-chain uptake of metals in the baseline ERA (i.e., site specific measurement) and how it differs from the approach used in the screening-level ERA.
USGS-19	2. Uptake may also be assumed to be spatially random, when in fact there may be preferential factors that attract organisms to contaminated sites. The roadside may provide some attraction for wildlife. Metals salts (including calcium chloride) might be attractive as salt-licks.	Medium	In the revised ERA, please discuss preferential wildlife utilization of the road corridor, how it may affect exposure estimates, and how this may result in non-conservative estimates of risk. Quantify the effect to the extent possible with existing data.

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	Sampling Design:		
USGS-20	1. A critical technical issue with the current draft RA is sampling design. NPS resources are inadequately considered in the current sampling design, with very limited sample locations positioned within Park boundaries immediately adjacent or within NANA (Northwest Arctic Native Association) easement within CAKR. This sampling design issue corresponds with our concerns related to reference sites which were poorly characterized relative to potential confounding factors (e.g., to differences in either biotic or abiotic components of habitat) apparent between higher elevation reference and lower elevation NPS lands adjacent (100-1000 meters) to the haul road.	High	Please respond regarding the need for additional sampling on NPS and NANA lands, and the applicability of the existing reference data set to NPS lands. In the revised RA, please indicate how limited sampling within CAKR may affect the strength of the risk estimates for receptors within CAKR.
USGS-21	2. There is also little basis for considering the geochemical similarities or differences in baseline conditions between the single reference location and the relatively large spatial area of NPS areas of concern.	High	In the revised RA, please describe the applicability of the existing reference data set to the "entire" site, and possible need to sample additional reference areas specific to CAKR.
USGS-22	3. Scale differences were not discussed relative to comparisons between reference sites versus area of concern. For example, *Exponent* did not consider the available published works from, e.g., USGS or NPS (either as NPS reports or in peer-reviewed literature) that might better [define] pre-mining baseline conditions of CAKR. *Exponent* has dismissed differences between reference and areas of concern without convincing arguments that the single reference location captures the range of communities at risk.	High	In the revised RA, please discuss deficiencies in the existing reference data set and ways to rectify it. See also recommendation for USGS-21.
	Reference Sites		
USGS-23	1. The selection of reference areas could have a significant influence on the two-tiered elimination process for selecting COPCs. For an ecological risk assessment of impacts within CAKR lands the reference areas should reflect the average mineralization for non-mining areas of the CAKR. Heavily mineralized areas having elevated metals concentrations would contribute bias in statistical comparisons with sites of mining operations. Sampling over a broader range of reference sites is clearly justified in that there are obvious changes in habitats that occur over several thousand meters of the haul road.	High	In the revised RA, please describe the applicability of the existing reference data to the CAKR and possible biases in site-to-reference area comparisons. Discuss the extent to which using limited reference data could lead to misidentification of COPCs and underestimation of site risks.
USGS-24	2. Reference areas should not be influenced by dust from the mining operations. Although soils data for the ecological reference sites appear reasonable in comparison with other Alaska soils (Gough and others, 1988), results by Hasselbach et al (2004) suggest that the ecological reference sites could have been affected by the aerial drift of dust from the mine site.	High	In the revised RA, please discuss the adequacy of the chosen reference locations in light of information presented in Hasselbach et al. (2004). If the existing reference data are biased high, describe the magnitude

No.	Comment	Priority	Recommendation
			of the effect on site-versus-background risk comparisons. Re-screen COPCs using NPS data to determine and discuss whether any COPCs were dropped inappropriately.
USGS-25	3. Data for mosses and lichens may have been more appropriate for differentiating metals concentrations in reference areas and sites adjacent to mine operations. There is considerable information and standardized practices for the use of mosses and lichens for monitoring environmental concentrations of metals that could have been appropriately applied.	Medium	Please provide response regarding lack of use of mosses in identifying true reference areas.
	Population vs. Local Effects:		
USGS-26	*1.* *Exponent* concludes that no population effects are predicted for wildlife and furthermore, recommends no restrictions for lands used by native subsistence hunter/gatherers. These conclusions are made despite clear documentation of significantly increased concentrations of COPCs in regions near the haul road, mine, and port site as a result of fugitive dusts. For example, overall "site" mean soil concentrations of cadmium, lead, and zinc are elevated by factors of 23, 30, and 23, respectively above the corresponding reference site means for the soils (human assessment, *Exponent* Table 3-4) and by factors of 44, 75, and 19, respectively, for the terrestrial tundra ecological assessment (*Exponent* Table 3-5). Moss samples analyzed by NPS indicated much greater enrichment (contamination) factors. Although conservative assumptions were in fact used to derive screening-level hazard quotients, overall subsistence use risks are calculated to be low or negligible based upon the low fractional intake from "the site" (0.09) estimated for the affected areas. This broad geographic assessment approach would be more defensible if the contaminated area was poorly defined or randomly distributed within a larger geographic area. Combining a defined geographically affected area (≤1,000 m within ore concentrate transportation vectors) with a much larger and presumptively unaffected area may discount overall risk, but would ignore risks to localized subsistence activities.	High	In the revised RA, indicate how high fractional intake can be before use restrictions are in order. Describe how likely such a fractional intake is for the site. For wildlife, unsupported conclusions about lack of risk to populations should be omitted from the revised RA.
USGS-27	2. Similarly, *Exponent* concludes that substantial risks are likely to individual voles, ptarmigan, and other biota in the vicinity of the haul road and port site, but population effects are expected to be low, so no action is needed. This conclusion may not be acceptable to NPS or to subsistence food gathering near the road. Therefore, a more focused risk assessment should be conducted specifically to determine if any action is needed for the affected area (e.g., hazard communication,	High	Omit unsupported conclusions about no population level effects to voles, ptarmigan, and other receptors from the revised ERA. Acknowledge that actions should be taken to further reduce emissions of fugitive dust

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	barriers, more effective fugitive dust reduction measures, or remediation).		during transport and storage of the ore concentrates.
USGS-28	3. The average site concentration of each COPC was used in ecological risk calculations despite wide ranges of concentrations in each environmental matrix sampled or considered during this RA. However, the average value is not necessarily the best statistical estimator of the central tendency of a population. The median would have been a better statistic for this purpose. Moreover, it would seem that values more representative of the worse-case concentrations, for example the upper 90th percentile concentration, could have also been applied for characterizing risks to the most susceptible receptors.	Medium	Please provide response regarding need to present additional risk estimates based on the median and/or 90th percentile concentration.
	Effects of Road Dust versus Ore Concentrate:		
USGS-29	*Exponent's* interpretation of dust and haul road interrelationships are generally poorly characterized, and their conclusions are poorly supported by citation to works readily available (but require some reading and placing those works into the context of the haul road and how it effects or does not effect adjacent lands). There is considerable literature on the effects of roads in Alaska and in Arctic latitudes. Much of road research in Alaska deals with impacts on caribou and other large mammals, e.g., caribou density is highly affected by the presence of roads regardless of the road's relationship to mining (Nelleman and Cameron 1998) and may serve as barriers to caribou movement (Whitten and Cameron 1983). To *Exponent's* advantage, contradictory studies have also be published, e.g., Cronin et al. 1998; Yost and Wright 2001; Burson et al. 2000) suggesting that development and roads appeared unrelated to caribou distribution or behavior. Although there is no unanimous conclusion, the majority of the research suggests that roads have a negative impact on caribou, especially female caribou and overall caribou movements. Any negative effect on female movement is particularly important because it potentially reduces the herd's reproductive capability.	High	Please consult the references cited by the USGS and add to the ERA a description of possible adverse impacts the haul road may have on movement of large mammals, such as caribou and moose.
USGS-30	While caribou have received the bulk of research efforts when roads are being considered as potential conditions adversely affect terrestrial wildlife, other large mammals have been the focus of field research. For example in interior Alaska, moose distribution was found to be less than expected in areas close to roads and rights-of-way in parks (Yost and Wright 2001; Burson et al. 2000). In contrast, Dall sheep, have not been found to be as impacted within NPS lands where roads have been constructed (Dalle-Molle and Van Horn 1991; Burson et al. 2000). Research on bears and roads in Alaska is limited, although a wide range of bear studies in other areas found an increased mortality associated with roads, and an avoidance of roads with human activity (e.g. Gibeau et al. 2002; Benn and Herrero 2002). Habituation, however, may influence any roads impacts, e.g., in Denali National Park grizzly bears occurred near roads more often	Medium	Please consult the references cited by the USGS and add to the ERA a discussion of possible adverse impacts the haul road may have on movement of large mammals. Consider the need to identify the haul road itself as a stressor.

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	than in previous years (Burson et al. 2000). Wolves south-central Alaska frequented roads with little human presence, but avoided areas that were used by humans (Thurber et al. 1994). Lynx displayed little avoidance of roads in the same region, but by using roads lynx were threatened by increased human-caused mortality (Bailey and Winthrop 1999). Similarly, caribou, grizzly bears, and raptors use roadsides for foraging and hunting, and this increased habitat use near roads has led to increased vehicle-caused mortality, lack of a sufficient food source, and related problems (Walker and Everett 1987).		
USGS-31	Based on first-hand observations, fugitive dusts from the haul road remain an issue for CAKR. Traffic on the haul road can release variously large amounts of dust, depending in part on environmental conditions (e.g., windy days *v.* calm days) and institutional controls (e.g., palliative dust control as institutional measures taken with application of $CaCl_2$). Within a landscape perspective, fugitive dust appears to be local, yet the impact can be wide-ranging, affecting vegetation, soils, ground ice, and wildlife (Walker and Everett 1987). Many of the impacts of dust in relation to wildlife occur because of increased snow melt adjacent to roads (Foreman et al. 2003, Auerbach et al. 1997). Early snow melt leads to an increase in the concentration of waterfowl, ptarmigan, and their predators near roads. Some bird species return early from migration because of early snow melt. Brabets (2004) has specifically reported on snow cover and dust interactions that directly or indirectly influence metal constituents common to ore concentrates transfer to Port Site via haul road that transects CAKR.	High	Please consult the references cited by the USGS and describe possible adverse impacts due to early snow melt in the revised ERA. Does early snowmelt along the haul road concentrate wildlife in areas were COPC levels are greatest? Do existing wildlife risk estimates account for this? If not, this shortcoming should be clearly described in the uncertainty section of the ERA.
USGS-32	From the perspective of dust as a physical stressor, Auerbach, et al (1997) intensively studied tundra adjacent to the gravel Dalton Highway in northern Alaska with a particular focus on effects of 15 years of chronic road and road dust disturbance. Mildly acidic (soil pH 5.0) and an acidic sites (soil pH < 5.0) differed with respect to susceptibility and sensitivity to road dust. Effects on vegetation were more pronounced in acidic tundra, which are evidently the baseline condition of tundra soils in CAKR. From the work of Auerbach, et al (1997), in these acidic soils initial substrate pH appears to control the degree of response to disturbance by road and calcareous road dust. Soils next to the road presented elevated pH readings and had lower nutrient levels, altered organic horizon depth, higher bulk density, and lower moisture. Vegetation biomass of most taxa was reduced near the road, and species richness in acidic tundra next to the road was less than half of that at 100 m away from the road. In acidic tundra soils, vegetation community composition was altered. Sphagnum mosses were dominant in acidic low arctic tussock tundra and virtually eliminated near the road at the acidic tundra site. *Salix lanata* was more abundant next to the road in nonacidic soils. Effects on snowpack were also noted, including increased drifting in the lee of the road and	High	Please ensure that the revised ERA adequately discusses all possible adverse impacts resulting from road use and dust emissions, particularly those described in this comment.

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	earlier meltout near the road due to dust-induced change in albedo. Thaw of permafrost was deeper on both sides of the road, and potentially could affect road structure detrimentally. Differential effects of road construction and use, including the long-term effects of hydrological alterations and dust mobilization on local corridors, are key information for planning development in areas of arctic tundra.		
USGS-33	*Exponent's* position that effects of road dust and metals associated as dust constituents (i.e., physical/chemical stressor effects associated with any road's dust) can not be distinguished from metal toxicity independent of physical stressor, is a technical point that may well be intractable. An analogy would be the interaction effects in a simple 2-way ANOVA wherein conclusions regarding the relationships of independent variables are intractably confounded by significant interactions between the two. Simply stated, we may never be able to tease out 'metal effects' from 'dust effects', since the two may be intractably linked and their effects are an expression of both chemical and physical attributes of the 'joint stressor'.	Low	In the revised RA, please ensure that adverse impacts, whether due to chemical or physical factors, are still identified as adverse impacts.
	III. Summary and Recommendations		
USGS-34	We conclude that contamination from aspects of the mining operation approaches thresholds for injury for certain biota along the DMTS. We anticipate that such injury to wildlife is likely limited to areas within 100 m of the road, but injury beyond distances of 1,000 m cannot be ruled out. For example, the RA indicates that lichens are impacted at 2,000 m and beyond. If future COPC inputs to the site are greatly reduced and documented, we do not feel that mitigative actions are necessary within this area, because the physical disruption of such actions are likely to be more injurious than existing contamination. Historical documents and land-lease agreements explicitly state the responsibility of Teck Cominco Alaska to minimize environmental impacts from Red Dog mine operations. Consequently, the development of a Risk Management Plan specific to this operation is needed. Considerable improvements in reducing fugitive dusts have been made, particularly at the port site, but there is no evidence or documentation that allows a quantitative assessment of these changes. Because it is not feasible to remove fugitive ore concentrate residues from haul trucks during the bulk of the year, a more efficient, less contaminating means for transferring concentrates or other methods of decontamination should be considered. Ecological risks are likely to increase from cumulative effects of COPCs if even low-level escapement of ore concentrates is allowed to continue.	High	The revised ERA should indicate that thresholds for adverse impacts have been exceeded for several receptor groups at the site, and that actions are necessary to further reduce emissions of fugitive dust during transport and storage of the ore concentrates.

Key:
ANOVA = Analysis of Variance
CAKR = Cape Krusenstren National Monument
COPC = Chemical of Potential Concern
DEC = Department of Environmental Conservation (Alaska)
DMTS = DeLong Mountain Regional Transportation System
ERA = Ecological Risk Assessment
NA = Not Applicable
NANA = Northwest Arctic Native Association
NPS = National Park Service
RA = Risk Assessment
TC = Teck Cominco
USGS = United States Geological Survey

Notes:
1. USGS comments were prepared by W. Brumbaugh, G. Linder, E. Little, T. May, and M. Mora, Columbia Environmental Research Center, 4200 New Haven Road, Columbia, Missouri for Peter Neitlich, National Park Service, Western Arctic National Parklands, Winthrop, Washington.
2. See original USGS comment letter for complete citations of cited literature.