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To: [Lindsey Cymbalisy - MVLWB](#)
Cc: craig@borealisgeopower.com; ashley@borealisgeopower.com
Subject: Borealis Response to MVLWB Interrogatories
Date: Friday, February 17, 2012 11:26:49 PM
Attachments: [BGP Master MV2012L4-0001 and MV2012X0001.xlsx](#)
[PastedGraphic-6.pdf](#)

Lindsey

Please find the XL table with our responses attached.

Of the 93 questions, we have been able to answer 91. The 2 outstanding are:

1. As discussed with yourself, the completion of an ERP. As agreed, this will be delivered to the MVLWB on or before Feb. 24, 2012, in good time for review prior to the technical hearing, currently scheduled for MARCH 7th.
2. We are awaiting further clarification from AANDC-WRD (Paul Green) on Query # 48, as to what site characteristics they wish described. Currently, we have a sense of the water table, the surface soils, the surface slope and the flora and fauna as outlined in the SNC Lavalin Site Assessment report. Absent further direction, we intend to rely on this information.

In addition, there are a number of documents contained in the shared Dropbox folder which have been added to the original submission and/or been revised to reflect the many helpful comments we have received.

In MVLWB - Borealis\ Feb 17 2012\, please find

1. Updated LUP Appln
2. Updated WP Appln
3. Updated SCP
4. Updated WMP
5. Master Response to all 93 Interrogatories
6. All Maps
7. Simulation Image referred to for SJ GeoPhysics question on Net Power generated

Should you have any additional questions or specific questions about our revised submissions, we will endeavour to answer them as best as we are able.

On our end, we are wondering at what time the 1st hearing - currently scheduled for March 7th, will become firm, so that we can make travel plans to have the team in Yellowknife ?

Regards,

Tim

#	ID	TOPIC	COMMENT	RECOMMENDATION	COMPANY RESPONSE
1	AANDC - SMD	Authorization for land use	Are the lands indicated in the application properly leased or permitted for under ownership of Beaver Enterprises? If so, under what authority or authorization?		<p>The land underlying the permanent site of the proposed geothermal power plant is leased to Beaver Enterprises, under a lease with the Federal Government. However, the broader area being applied for under the LUP & WP's includes lands which are not currently under lease with the federal Government. The ADKFN & Beaver Enterprises are currently working with various bodies to remedy this situation, but as it may not be resolved prior to our hearing, we have applied for a full permit for drilling and ongoing activities, as if the project were not located near any form of infrastructure.</p>

2	AANDC - SMD	Restoration Plans	Should this project not proceed, what are the company's restoration plans?		<p>The critical decision point on proceeding with the project will come at the conclusion of drilling the 1st well - the production well. The subsurface data will or will not confirm the initial hypotheses regarding flow, temperature, water quality and permeability. If these variables are insufficient to sustain the mooted power production, the well (1) will be abandoned, in accord with standard Oil & Gas practices and relevant legislation, and the site will be returned to the Beaver Enterprises. Beaver Enterprises has indicated that they will not restore the site, instead preferring to have additional cleared land where they have a valid Federal Lease.</p>
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3	AANDC - SMD	Waste and sewage	In regards to where waste and sewage will be hauled to and disposed of outside the NWT, is there currently an agreement in place? More information is required related to this.		Hazardous and drilling waste is to be contained and transported outside of the NWT, near Fort Nelson, BC. Hazardous and/or non-hazardous solid drilling waste will be transported to the CCS Northern Rockies facility, while the hazardous and/or non-hazardous fluid drilling waste will be transported to the CCS Sierra facility. The Letter of Agreement with CCS has been included in the Appendix of the Waste Management Plan. Hazardous waste will be stored in appropriate hazardous waste containers. Hazardous waste will be transferred in an appropriate manner. Hazardous waste will be transported in vehicles permitted to carry and will be delivered to a site permitted to accept.
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4	AANDC - SMD	Garbage, brush and overburden	How will the contractor (Beaver Enterprises) deal with garbage, brush, and overburden? More detail is required.		<p>As noted in our application, we find it necessary to clear ~1,375 m² (55m x 25m) of bush, in order to locate the permanent facility on lands properly leased to Beaver Enterprises. It is expected that Beaver Enterprises will be conducting the site preparation, which included the removal of trees, bushes, and some surface site preparation. The work would proceed after appropriate examination for the wide variety of environmental issues which accompany clearing such a site (eg. search and mitigation for species at risk, search and relocation of migratory bird nests, work to be performed in the appropriate window defined by the bird migration, et al). Further, large trees would be cut, stacked, and sold as timber. Smaller bushes, branches, waste wood are expected to be burnt in waste piles. Overburden would be collected and used later as part of the berms for the various waste collection tanks which will be located within the drilling permit boundaries.</p>
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5	AANDC - SMD	Land Lease	Lands Administration has advised that Borealis Geopower would be required to file a land lease application for this site after land use operations are completed, should the power plant become permanent in nature. A surface land lease at this locations would be required for industrial power plant purposes.		We are aware and recognize that, upon the expiry of the existing permits, additional permits would be required for the ongoing long term operation of the geothermal power plant
6	EC	General	The following comments and requests for further information are preliminary in nature and should in no way limit the scope of any future analyses. Information requests and a detailed written technical intervention containing our recommendations will be submitted as required during the review process.		No comment required
7	EC	General	All mitigation measures identified by the Proponent, and the additional measures suggested herein, should be strictly adhered to in conducting Project activities. This will require awareness on the part of the Proponents' representatives (including contractors) conducting operations in the field.	EC recommends that all field operations staff be made aware of the Proponents' commitments to these mitigation measures and provided with appropriate advice / training on how to implement these measures.	We are aware of and will be complying with the need to train all field operations staff on recognizing environmental challenges and the appropriate mitigation schemes.

8	EC	Water Quality	<p>Meeting the requirements of the <i>Fisheries Act</i> is mandatory, irrespective of any other regulatory or permitting system. Section 36(3) of the <i>Fisheries Act</i> specifies that unless authorized by federal regulation, no person shall deposit or permit the deposit of deleterious substances of any type in water frequented by fish, or in any place under any conditions where the deleterious substance, or any other deleterious substance that results from the deposit of the deleterious substance, may enter any such water. The legal definition of deleterious substance provided in section 34(1) of the <i>Fisheries Act</i>, in conjunction with court rulings, provides a very broad interpretation of deleterious and includes any substance with a potentially harmful chemical, physical or biological effect on fish or fish habitat.</p>		<p>We understand and will comply with the relevant sections of the Fisheries Act.</p>
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9	EC	Fuel / Spill Contingency	<p>Please note the new CEPA Storage Tank System for Petroleum Products and Allied Petroleum Products Regulations that came into force on June 12, 2008. These regulations apply to both outside, aboveground and underground storage tank systems (including the piping and other tank associated equipment) under federal jurisdiction containing petroleum and allied petroleum products that have a capacity greater than 230 litres. This includes tanks located on federal or Aboriginal lands. Exceptions are pressurized tanks, mobile tanks, tanks regulated by the National Energy Board, and outdoor, aboveground storage tank systems that have a total combined capacity of 2500 litres or less and are connected to a heating appliance or emergency generator. All storage tank system owners must identify their tank systems to EC and installation of new systems must comply with the regulation's design requirements. Further information on these regulations can be found at www.ec.gc.ca/st-rs.</p>	<p>EC recommends that the Proponent ensure that they are in compliance with the CEPA <i>Storage Tank System for Petroleum Products and Allied Petroleum Products Regulations</i>.</p>	<p>We understand and will comply with the CEPA Storage Tank System for Petroleum Products and Allied Petroleum Products Regulations.</p>
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10	EC	Fuel / Spill Contingency	EC offers the following comments for fuel transfer operations	Transfer operations should be attended by trained personnel at all times; secondary containment or a surface liner (drip pans, fold-a-tanks, etc.) should be placed under all containers or vehicle fuel tank inlet and outlet points, hose connections and hose ends during fuel or hazardous substance transfers; and secondary containment should be of adequate size and volume to contain and hold fluids for the purpose of preventing spills (the worst-case scenario).	We are aware of and will be complying with the need to train all field operations staff on recognizing the requirements for and using safe and clean practices for fuel transfers, transfers of hazardous substances, and/or transfers of any potential polluting substance on our site.
11	EC	Fuel / Spill Contingency	Please note that any spill of fuel or hazardous / deleterious materials, adjacent to or into a water body, regardless of quantity must be reported immediately to the NWT 24-hour Spill Line, (867) 920-8130.	Any spill of fuel or hazardous / deleterious materials, adjacent to or into a water body, regardless of quantity must be reported immediately to the NWT 24-hour Spill Line, (867) 920-8130.	We will report any spills to the NWT Spill Line
12	EC	Waste Treatment & Disposal	The Proponent should ensure that any fuel or hazardous wastes associated with the proposed Project are to be properly handled, transported and disposed of at an approved disposal site.	EC recommends that the Proponent ensure that any fuel or hazardous wastes associated with the proposed Project are to be properly handled, transported and disposed of at an approved disposal site.	As per our response to query #3, all these conditions will be met.

13	EC	Wildlife	<p>In Section 7 of the Proponents Land Use Permit application (MV2012X0001) it is stated that the drill pad and power generation facilities are to be erected directly on existing brownfield sites, but that a small area south of the brownfield site may be cleared and leveled to allow the drill pad and plant facility to fit appropriately on the site with existing Beaver Enterprises base camp structures. The exact area of forest and shrub cover to be cleared is not provided, however it is stated that in Section 1.1 of the Environment Assessment Report (December 2011) that the electrical generation plant footprint is estimated to be 40 m × 20 m and the drilling site is estimated to be up to 100 m × 100 m. Section 5.2 states that a small open water cooling pond measuring 20 m by 30 m will be developed.</p>	<p>EC requests that the Proponent specify the projected area that will require vegetation clearing.</p>	<p>See Drill Pad and Plant Site Map.</p>
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14	EC	Wildlife	<p>Section 6 (a) of the <i>Migratory Birds Regulations</i> states that no one shall disturb or destroy the nests or eggs of migratory birds. Clearing vegetation during the migratory bird breeding season increases the risk of disturbing or destroying nests or eggs of migratory birds. The best mitigation measure to ensure compliance and to minimize the impacts of the project would be to locate the proposed geothermal facility, including the drill pad and cooling pond, entirely within the existing brownfield site such that no vegetation clearing would be required.</p>	<p>EC recommends the Proponent investigate the feasibility of re-locating the geothermal plant to within the boundary of the existing brownfield site or provide a more detailed rationale as to why it is necessary to disturb additional areas of mature forest adjacent to the existing clearing.</p>	<p>The bulk of the brownfield site has not been appropriately leased from the Federal Government by Beaver Enterprises. As such, we are not able to locate the project fully onto the brownfield site. To the degree that we are able, we are utilizing available brownfield space, to minimize the amount of forest clearing necessary to accommodate the facility.</p>
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15	EC	Wildlife	<p>Section 2.7 (pg. 19) of the Proponent's Environmental Assessment Report states that: "If clearing of vegetation is to occur for the project, attempt to schedule the clearing activities outside the "breeding bird window". Clearing should occur between September 1 and April 1. If clearing needs to occur within the breeding bird period (April 15 to Aug 15), then bird nest searches by qualified biologists would be required in order for clearing to proceed." Although this is generally consistent with standard advice provided by EC, it should be noted that the breeding period for migratory birds in boreal region of the Northwest Territories may be later than that specified by the Proponent. In the boreal region of the Northwest Territories, migratory birds may be found incubating eggs from May 7 until July 21, and young birds can be present in the nest until August 10. Crossbills (medium-sized finch-like birds) may nest at any time of year if there are sufficient numbers of seeds from conifer cones for food.</p>		<p>We commit to ensuring that any clearing of forest would proceed outside the "breeding bird window" - as defined by the local and migratory species found in the Ft. Liard area. Further, a pre-clearing examination will be conducted by a qualified biologist on the proposed area to be cleared, to identify and relocate any existing nests.</p>
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16	EC	Wildlife	<p>Food, domestic wastes, and petroleum-based chemicals (e.g., greases, gasoline, glycol-based antifreeze) should be made inaccessible to wildlife at all times. Such items can attract predators of migratory birds such as foxes, ravens, gulls, and bears. Although these animals may initially be attracted to the novel food sources, they often will also eat eggs and young birds in the area. These predators can have significant negative effects on the local bird populations.</p>	<p>EC recommends that food, domestic wastes, and petroleum-based chemicals (e.g., greases, gasoline, glycol-based antifreeze) be made inaccessible to wildlife at all times. Such items can attract predators of migratory birds such as foxes, ravens, gulls, and bears. Although these animals may initially be attracted to the novel food sources, they often will also eat eggs and young birds in the area. These predators can have significant negative effects on the local bird populations.</p>	<p>All wastes will be stored on site in wildlife proof containers. This is addressed in multiple sections of the Waste Management Plan: 2.1.1 Domestic Waste, 2.1.2 Recycling, 2.1.5 Other Waste.</p>
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17	EC	Wildlife	<p>The following comments are pursuant to the SARA, which came into full effect on June 1, 2004. Section 79 (2) of SARA, states that during an assessment of effects of a project, the adverse effects of the project on listed wildlife species and its critical habitat must be identified, that measures are taken to avoid or lessen those effects, and that the effects need to be monitored. This section applies to all species listed on Schedule 1 of SARA. However, as a matter of best practice, EC suggests that species on other Schedules of SARA and under consideration for listing on SARA, including those designated as at risk by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), be considered during an environmental assessment in a similar manner. Table 1 lists species that may be encountered in the Project area that have been assessed by COSEWIC as well as their current listing on Schedules 1-3 of SARA (and designation if different from that of COSEWIC). Project impacts could include species disturbance, attraction to operations and habitat destruction.</p>	<p>See table included in EC's original letter to the MLVWB. For any Species at Risk that could be encountered or affected by the Project, the Proponent should note any potential adverse effects of the Project to the species, its habitat, and / or its residence. All direct, indirect, and cumulative effects should be considered. Refer to species status reports and other information on the Species at Risk registry at www.sararegistry.gc.ca for information on specific species as well as the booklet "Species at Risk in the Northwest Territories" (2010 Edition) available at http://www.enr.gov.nt.ca/_live/pages/wpPages/Species_at_Risk.aspx</p>	<p>These notations and mitigation options are included within pp.7-8 & 14-20 of the SNC Lavalin Report already filed with the Board.</p>
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18	EC	Wildlife	<p>The following comments are pursuant to the SARA, which came into full effect on June 1, 2004. Section 79 (2) of SARA, states that during an assessment of effects of a project, the adverse effects of the project on listed wildlife species and its critical habitat must be identified, that measures are taken to avoid or lessen those effects, and that the effects need to be monitored. This section applies to all species listed on Schedule 1 of SARA. However, as a matter of best practice, EC suggests that species on other Schedules of SARA and under consideration for listing on SARA, including those designated as at risk by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), be considered during an environmental assessment in a similar manner. Table 1 lists species that may be encountered in the Project area that have been assessed by COSEWIC as well as their current listing on Schedules 1-3 of SARA (and designation if different from that of COSEWIC). Project impacts could include species disturbance, attraction to operations and habitat destruction.</p>	<p>See table included in EC's original letter to the MLVWB. If Species at Risk are encountered or affected, the primary mitigation measure should be avoidance. The Proponent should avoid contact with or disturbance to each species, its habitat and / or its residence.</p>	<p>To the degree that the proposed plant can be located in such a manner as to minimize its impact on Species at Risk, this will be done. Our understanding is that the proposed site includes no species at risk. However, a pre-clearing audit of these species will occur, and insofar as there are viable alternate locations that also meet the requisite legal and physical constraints, these will be preferred over other mitigation measures.</p>
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19	EC	Wildlife	<p>The following comments are pursuant to the SARA, which came into full effect on June 1, 2004. Section 79 (2) of SARA, states that during an assessment of effects of a project, the adverse effects of the project on listed wildlife species and its critical habitat must be identified, that measures are taken to avoid or lessen those effects, and that the effects need to be monitored. This section applies to all species listed on Schedule 1 of SARA. However, as a matter of best practice, EC suggests that species on other Schedules of SARA and under consideration for listing on SARA, including those designated as at risk by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), be considered during an environmental assessment in a similar manner. Table 1 lists species that may be encountered in the Project area that have been assessed by COSEWIC as well as their current listing on Schedules 1-3 of SARA (and designation if different from that of COSEWIC). Project impacts could include species disturbance, attraction to operations and habitat destruction.</p>	<p>See table included in EC's original letter to the MLVWB. Monitoring should be undertaken by the Proponent to determine the effectiveness of mitigation and / or identify where further mitigation is required. As a minimum, this monitoring should include recording the locations and dates of any observations of Species at Risk, behaviour or actions taken by the animals when project activities were encountered, and any actions taken by the Proponent to avoid contact or disturbance to the species, its habitat, and / or its residence. This information should be submitted to the appropriate regulators and organizations with management responsibility for that species, as requested.</p>	<p>As per our mitigation strategies identified in the SNC Lavalin document, we agree to monitor any interaction with a Species at Risk and follow the appropriate mitigation scheme as laid out therein.</p>
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20	EC	Wildlife	<p>The following comments are pursuant to the SARA, which came into full effect on June 1, 2004. Section 79 (2) of SARA, states that during an assessment of effects of a project, the adverse effects of the project on listed wildlife species and its critical habitat must be identified, that measures are taken to avoid or lessen those effects, and that the effects need to be monitored. This section applies to all species listed on Schedule 1 of SARA. However, as a matter of best practice, EC suggests that species on other Schedules of SARA and under consideration for listing on SARA, including those designated as at risk by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), be considered during an environmental assessment in a similar manner. Table 1 lists species that may be encountered in the Project area that have been assessed by COSEWIC as well as their current listing on Schedules 1-3 of SARA (and designation if different from that of COSEWIC). Project impacts could include species disturbance, attraction to operations and habitat destruction.</p>	<p>See table included in EC's original letter to the MLVWB. For species primarily managed by the Territorial Government, the Territorial Government should be consulted to identify other appropriate mitigation and / or monitoring measures to minimize effects to these species from the project.</p>	<p>By way of copy through this review process, the Territorial Government has been notified of our proposed mitigation schemes for those Species at Risk which they manage.</p>
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21	EC	Wildlife	<p>The following comments are pursuant to the SARA, which came into full effect on June 1, 2004. Section 79 (2) of SARA, states that during an assessment of effects of a project, the adverse effects of the project on listed wildlife species and its critical habitat must be identified, that measures are taken to avoid or lessen those effects, and that the effects need to be monitored. This section applies to all species listed on Schedule 1 of SARA. However, as a matter of best practice, EC suggests that species on other Schedules of SARA and under consideration for listing on SARA, including those designated as at risk by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), be considered during an environmental assessment in a similar manner. Table 1 lists species that may be encountered in the Project area that have been assessed by COSEWIC as well as their current listing on Schedules 1-3 of SARA (and designation if different from that of COSEWIC). Project impacts could include species disturbance, attraction to operations and habitat destruction.</p>	<p>See table included in EC's original letter to the MLVWB. Mitigation and monitoring measures must be taken in a way that is consistent with applicable recovery strategies and action / management plans.</p>	<p>We commit to take deploy mitigation schemes consistent with applicable recovery strategies and action/management plans</p>
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22	EC	Wildlife	Implementation of these measures may help to reduce or eliminate some effects of the Project on migratory birds and Species at Risk, but will not necessarily ensure that the Proponent remains in compliance with the MBCA, <i>Migratory Birds Regulations</i> , and the SARA.	The Proponent must ensure they remain in compliance during all phases and in all undertakings related to the Project.	We commit to do so
23	AANDC - WRD	Fort Liard Geothermal Project - Groundwater elevation	Section 4 of the water licene application identifies that the water table is located at ~6" below ground surface.	Please confirm the local water table depth.	The water table at the Fort Liard municipal water works, located approximately 3km from our proposed site, varies between 8-10m deep - to top of groundwater. These figures vary depending on annual rainfall and time of season. This represents the only available datapoint for ground water in the area.

24	AANDC - WRD	Fort Liard Geothermal Project - Groundwater and drilling operation	It is stated under section 5.3 - Mitigation of impacts of SNC Lavalin Environmental Assessment - that the complete drilling operation will follow accepted standardized practices described in federal and territorial water management and drilling waste management guidelines. The specific guidelines referred to for proper design should be specifically detailed within the application when appropriate, and not only in the References section.	AANDC recommends that Guidelines referred to in the application be stated and described where appropriate.	Borealis has relied on well design services from Codeco Energy Group to ensure that our well design conforms to all required specifications as per National Energy Board (NEB) "Drilling and Production Guidelines" (COGOA: Canada Oil and Gas Operations Act). If there is any uncertainty or gaps in these regulations for our specific drilling application, we will be following the more detailed ERCB (Energy Resources Conversation Board) regulations. An example of this is the "Director 008 Surface Casing Depth Requirements" for protecting groundwater with surface casing. Adhering to these extensive drilling regulations for well design and drilling procedures (including casing, cementing and pressure testing) is standard practice for all oilfield wells drilled in the Western Canada Sedimentary basin, including those in the NWT.
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25	AANDC - WRD	Groundwater protection - Well(s) drilling stage	<p>It is important to ensure that the drilling and completion of the wells to be used in this project are done in such a manner as to ensure that groundwater contamination does not occur, now or in the future. Specific details on measures to protect groundwater resources such as the cementing of wells, the monitoring of their performance over time, as well as the monitoring of re-injected fluids are not fully provided in the application.</p>	<p>AANDC recommends that that proponent provide specific details on how groundwater resources will be protected, and how that protection will be monitored, throughout the life of the project. Local groundwater conditions should be characterized (physically and chemically) to allow for identification of any impacts.</p>	<p>For both wells, The primary mechanism for protecting the groundwater is to isolate and protect it from the deep geofluid with two cemented casings and production tubing. For the producer, this consists of 406mm/298mm casing run to 500m depth with production tubing run the rest of the way to 4,165m depth. For the injector, this consists of 340mm/245mm casing run to 365m with 178mm production casing run to 730m.</p> <p>The casing itself is a nickel alloy steel, whose specifications meet or exceed that requisite to prevent corrosion breakthrough from the geofluid.</p> <p>This philosophy extends to the system maintenance, where the entirety of the heat exchange, production turbine, and cooling/condensing loops for the geofluid and the binary fluid are contained indoors. This allows maintenance to proceed in a closed environment where any maintenance related discharges of the primary or binary fluid will be collected. Further, a cement floor</p>
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26	AANDC - WRD	Fort Liard Geothermal Project - Migration of re-injected fluids	Details on subsurface geological formations should be provided, specifically, whether or not the characteristics of the overlying geological formations are suitable to prevent the migration of re-injected fluids into potable groundwater zones. Has any information been collected on the location of potable water zones in the project area?	AANDC recommends that this information be provided.	The details on subsurface geologic formations and their suitability to contain re-injected fluids has been prepared and provided on February 5, 2012, when Borealis GeoPower submitted additional information entitled "Geological Analysis on Re-injection for Fort Liard Geothermal Project." On a separate note, no information has been collected on potable water zones in the area as the minimum surface casing depth of either well is 365m, well below any notional potable water zone.
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27	AANDC - WRD	Fort Liard Geothermal project - Drilling Mud & Additives	<p>The Spill Contingency Plan, Table 3 - Job Specific Hazardous Materials, describes that drilling mud will be stored onsite in 49.1 m³ capacity container while drilling the wells. Appendix 4 of the SCP (p. 39) states that MSDS sheets for mud additives will be provided by the Mud Supplier. It is also stated in the Environmental Assessment prepared by SNC Lavalin, under section 5.2, that all drilling fluids regardless of the type will be disposed of via trucking to a suitable disposal site in northeastern BC. The chemical composition of drilling mud and drilling chemicals to be used in the project should be provided within this application. Once provided, the project Spill Contingency Plan and Waste Management Plan should be updated accordingly.</p>	<p>AANDC recommends that the chemical composition of the the drilling mud and additives be provided and incorporated within the Spill Contingency Plan.</p>	<p>The proposed mud system will primarily use a diesel invert mud. The chemical composition of this has been provided and incorporated into the Spill Contingency Plan (p. 22). On occasion, to increase lubricity, reduce the effects of temperature on the mud et al, additional additives are sometimes needed. The specific details of these are difficult to ascertain at this time. However, we propose that prior to any additional chemical being brought on site, that we provide a full chemical analysis to relevant inspecting agency, along with updating and incorporating any such chemicals into the Spill Contingency Plan, and obtain their approval to proceed prior to deploying any such additives.</p>
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28	AANDC - WRD	Fort Liard Geothermal project - Chemical composition of binary fluids	Borealis Geopower presentation presented information on the Binary Cycle Power Plant which describes that a secondary fluid is vaporized into steam and used to power turbine to generate electricity. The Spill Contingency Plan, p. 12, describe binary fluids as "non-toxic organic refrigerant". The SCP also states that approximately 15,000 litres of binary fluid will compose the closed-loop geothermal system. The chemical composition of the binary fluid was not provided within the application.	AANDC recommends that the chemical composition of the binary fluid be provided within this application.	The MSDS sheets for R245FA, the proposed binary fluid, have been added to the Spill Contingency Plan.
29	AANDC - WRD	Fort Liard Geothermal Project - Development Path	The Development Path diagram - Phase 2 "Drilling and Confirming" (p. 103 of the LUP application) refers to testing of geothermal fluid chemistry, pressure, porosity and flow rate. It is understood that the commencement of Phase 2 will occur with the receipt of the water licence and land use permit.	AANDC considers results from geothermal fluid chemistry, pressure, porosity and flow rate testings to be valuable information. This information should be submitted as a condition of the water licence, once available.	We agree to submitting this information, as it becomes available. Further, Borealis seeks permission to disseminate this information into the public domain, through scientific publications, as part of a broader initiative to encourage further geothermal developments in the Northwest Territories.

30	AANDC - WRD	Fort Liard Geothermal project - Cooling pond	<p>Section 5 of the Land Use permit application form states that the geothermal Plant components are to include a production and an injection well connected via a ~15 meter flow line to a power generation unit. The power generation unit will be housed in a structure and will include an appropriately safeguarded cooling pond. Please describe which safeguarding measure will be used in order to prevent public or animals to access the cooling pond. As well, section 10 of the water licence states that "should there be a leak or spill of the plant fluid outside the closed-looped system, the pond will have been constructed adhering to proper fluid/hazardous materials containment/storage guidelines and have strong enough liners to ensure no hazardous fluid leakage to the surface or subsurface environment." The specific guideline(s) referred to for proper design should be detailed within the application where appropriate.</p>	<p>AANDC recommends that guidelines referred to in the application be detailed where appropriate and provided so that intervenors can refer to as needed.</p>	<p>In its initial design, Borealis has developed two options for the geothermal plant, one air cooled and the other water cooled. As such, Borealis has included a cooling pond in its LUP and WP applications as an option, rather than a primary design feature. Further, at the time of submission, we informed the MVLWB of the optional nature of the pond. At this juncture, we are unable to provide sufficient information about the operation of the pond, insofar as we cannot, absent a significant history of operation, characterize the necessary inflows and outflows of water, notably from precipitation and evaporation. Further, we cannot a priori determine what chemicals are necessary to properly manage any unwanted growths of algae, insects et al. As such, we are electing to drop the pond from both our design and the LUP & WP applications. They have both been revised to reflect this change.</p>
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31	AANDC - WRD	Fort Liard Geothermal project - Cooling pond	Section 7 of the Water Licence Application (Quantity of Water Involved) indicates that a total of 50,000L of water will be required for the cooling pond. There will be evaporative losses from the cooling pond and it is not clear what volume of water will be required, on an ongoing basis, to replace water lost to evaporation.	Please identify the volume of water that will be required on an on-going basis to replace water lost to evaporation. Please also identify the source of such make-up water.	Please refer to the response for #30
32	AANDC - WRD	Fort Liard Geothermal project - Cooling pond	The cooling pond will be covered with netting to prevent birds from accessing the pond, but the pond will otherwise be open. The warm water contained within the pond may promote the growth of algae, insects, etc. The application does not identify whether this may be an issue or whether biocides would be required to minimize unwanted growth.	Please confirm whether biocides will be required to reduce biological activity in the cooling pond.	Please refer to the response for #30

33	AANDC - WRD	Spill Contingency Plan - format	<p>The actual Spill Contingency Plan (SCP) document does not have section numbers or page numbering. In order to make best use of the spill contingency plan, page numbers corresponding to those provided in the Table of contents should be placed within the document, so readers can quickly refer to the desired information. Section numbers for each SCP section and sub-section presented should be inserted for easy tracking rather than using name headings alone. Please note that page numbers provided in below comments for the SCP refer to the electronic page number when using the document digitally, as page numbers are currently missing from the document.</p>	<p>AANDC recommends that the Borealis Geopower SCP be updated in order to best assist the proponent during emergency situations.</p>	<p>The Spill contingency Plan has been updated as requested.</p>
34	AANDC - WRD	Spill Contingency Plan - Secondary fluids	<p>The current SCP provides characteristics for several types of wastes found on site (gasoline, diesel fluid, propane, salt formation water, H2S, etc.) but similar information is not available for geothermal secondary fluids.</p>	<p>The section found at the end of the SCP should also include a MSDS sheet for the secondary/binary fluids.</p>	<p>The Spill contingency Plan has been updated as requested.</p>

35	AANDC - WRD	Spill Contingency Plan - Procedures specific to each type of spill	<p>Procedures for Initial Action found on p. 21 of the Spill Contingency needs to provide further details in order to assist staff onsite in responding with the adequate emergency response to an eventual spill situation. Procedures for spill response, up to and including a worst case spill scenario, should be provided specifically for spills of each type of potential waste found on site.</p> <p>AANDC is specifically interested in procedures required to address a worst case scenario associated with a spill of geothermal fluids. These fluids will be highly mineralized, at a potential temperature of 120°C, and flowing at a potential discharge rate of up to 2,225,000 L/day (SCP, Table 3).</p>	<p>AANDC believes that detailed spill response and containment procedures should be provided by product, up to an including a worst case scenario event.</p>	<p>Defining a worst case scenario for the releases of geofluid requires some level of understanding of the geothermal plant design and operation.</p> <p>From a design perspective, at the surface, there are a number of interconnected vales, pipes, and pieces of equipment. As such, in the event of an unexpected failure in any of these pieces, the amount of geofluid that can be released is quite limited. Further, despite containing a significant (~4,000 L) of geofluid at any one time, the equipment does not naturally 'drain out'. Given this, the worst case scenario would be an event which would sheer the well head right off the production well, essentially creating an unconstrained (at the surface) open hole. This is not as easy as it sounds, as the well head is a block of steel, in excess of 1 tonne, which is bolted to a 16" carbon alloy well casing. However, assuming some event were strong enough to accomplish this, we believe that this would be the worst case scenario.</p>
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36	AANDC - WRD	Spill Contingency Plan - Spill Response Team	<p>The proponent is refers to the "Field Response Team" and to the "Spill Response Team" in it document. Are these two terms meant to represent the same individuals? More description should be provided when referring to the Spill Response Team such as who these people are (if no name currently available; then positions/titles) as well as contact information. A diagram with line of communication for the Spill Response Team should be provided within the SCP in order A</p> <p>The contact information of each members of the Spill Response Team should also be provided within Figure 4 - Flow chart of Response Organization.</p>	AANDC recommends that the SCP be updated to this necessary information.	The Spill contingency Plan has been updated as requested.
37	AANDC - WRD	Spill Contingency Plan - Contact information	<p>The following updates should made to the "Flow Chart of Response Organization":</p> <ul style="list-style-type: none"> -On-site personnel contact information should be included. -INAC should be replaced by AANDC <p>Emergency contacts found in Table 5 should include names, respective titles and telephone numbers of on-site personnel.</p> <p>Fort Liard Fire Department contact information should also be included in the Table 5 Emergency Contact List.</p>	AANDC recommends that this contact information be updated within the SCP.	The Spill contingency Plan has been updated as requested, with drilling contractor information to be supplied once a competitive bidding award process has been concluded.

38	AANDC - WRD	Spill Contingency Plan - Potential Environmental Impacts of Spill	Snow is described as a natural sorbent and ice as a barrier which both could prevent spill from contaminating soil and water; as well as facilitate spill recovery (SCP, p. 18). However, a spill of high temperature and high salinity geothermal fluids could rapidly degrade snow and/or ice cover. The SCP should include specific procedures to conduct a rapid and effective recovery and containment of potentially large quantities of geothermal fluids.	The SCP should be updated to include appropriate spill containment and response procedures for geothermal fluids.	The Spill contingency Plan has been updated as requested.
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39	AANDC - WRD	Spill Contingency Plan - Trenching to Bedrock and/or Permafrost for Spill Containment	<p>The SCP, p. 27, states that a trench can be dug in order to contain spills. More specifically it recommends that the trench be dug to the bedrock or permafrost, which would then provide a containment layer for spilled fuel which would ultimately be recovered using a pump or sorbent materials. Have bedrock and/or permafrost depths been characterized in the project area? This would aid in spill response planning.</p> <p>The application identifies that the water table is located 6" below surface. Should trenches be conducted to a depth lower than the water table, groundwater resources would potentially be affected and the volumes of contaminated water for the responder to manage would likely increase substantially. It is not advisable to construct trenches in areas of shallow groundwater for use in spill containment/collection.</p>	AANDC recommends that trenches not be constructed near or into the local water table for containment of spilled product.	The Spill contingency Plan has been updated as requested.
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40	AANDC - WRD	Spill Contingency Plan - Burning	It is stated under Containment of spill on Snow (SCP, p. 28) that the use of burning snow cone can be employed if/when the spill can be isolated from the source. Burning is not a preferred spill response method, however, it may be considered for use depending upon the situation. Burning should only occur following the approval of an AANDC Inspector.	The SCP should be updated to indicate that approval of the AANDC Inspector is required to utilize burning as a spill response method.	The Spill contingency Plan has been updated as requested.
41	AANDC - WRD	Spill Contingency Plan - Spill Under Ice	It is stated under Containment of spill on Ice (SCP, p. 28) that all possible attempts should be made to prevent spills from entering ice covered waters as no easy method exists for containment and recovery of spills if they seep under ice. While recovery of spilled product under ice is challenging, it should be clarified that spill recovery techniques under ice exist and can be successful. Such procedures should be provided within the SCP to provide guidance to staff should a spill under ice occur.	AANDC recommends the SCP to be updated to contain spill recovery and contingency procedures for all potential spill scenarios.	The Spill contingency Plan has been updated as requested. The procedures for spills that occur on small amounts of ice on a land surface (i.e. not a water body) were detailed. It was also noted that since the project is a large distance (>500m) from the closest water body, Hay Lake, which is sits at a higher elevation than the project site itself, and >1.5 km from the second closest water body, the Liard River, then the potential of a spill ever reaching a water body is simply not possible, given our worst-case spillvolume of ~800 L.

42	AANDC - WRD	Spill Contingency Plan - Blowout Preventer (BOP)	<p>The SCP, p. 20, describes the expected procedures when experiencing an uncontrolled water/gas flow to the surface while drilling, also called a "kick". A Blowout Preventer drill is to be conducted every seven calendar day. According to the SCP, one of the first step if the well starts flowing water will normally be rigging up to kill the well so the wellhead can be removed and installation/replacement of the BOP stack can occur. AANDC would require clarification as to whether or not a BOP could already be installed and available immediately in the event of an emergency, especially since the well is to be drilled through geological formations which may contain sour gas.</p>	<p>AANDC recommends that additional clarification be provided as to whether or not a BOP could already be installed and available immediately in the event of an emergency. If such a system is possible AANDC recommends that a BOP be installed and readily available during operations, rather than waiting until an emergency event occurs.</p>	<p>The event this query refers to, in the Spill Contingency Plan, is a point in time where potential spills could occur. However, there appears to be some confusion in the question itself as to the potential role played by natural gas kick in the formation and the use of a Blow Out Preventer to mitigate them.</p> <p>We believe that there is a small probability that we could encounter a small volume of natural gas as we enter the Nahanni zone during production drilling. Even in circumstances where drillers believe there is no chance of encountering gas, its absence is almost impossible to prove definitively. As such, it is standard operating procedure to have more than one control mechanism in place to prevent loss of well control. The Blow Out Preventer (BOP), installed during the onset of drilling, represents the second line of defence against loss of well control. (the first is the use of mud to control downhole pressure and hence flow)</p>
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43	AANDC - WRD	Spill Contingency Plan - H2S	<p>A report prepared by BEHR Energy Services Ltd, stipulated on p.1 that the project drilling wells have the potential to be considered "Proximity Critical" due to the proximity to Ft. Liard and the extent of the Drilling and Completion/Service operations release rates of H2S. There was no "Emergency Response Plan" provided with the application.</p> <p>Oil and Gas wells drilled in the NWT require submission of an Emergency Response Plan, as well as a spill contingency plan. It is recognized that some portions of the 2 documents will be similar. However, very limited details with respect to emergency response incidents, such as a release of sour gas, were provided within the application. A full emergency response plan must be developed. The proponent could use ERPs from oil and gas operations across the NWT as a guide for development.</p>	<p>AANDC recommends that a detailed Emergency Response Plan be developed by the proponent and define response procedures for all potential emergencies from the project, including but not limited to the following:</p> <ol style="list-style-type: none"> 1. Release of sour gas 2. Uncontrolled spill 3. Medical Emergencies 4. Wildlife encounters 5. Fire 	<p>We have committed to having a full ERP to the MVLWB by February 24, 2012</p>
44	AANDC - WRD	Spill Contingency Plan - Potentially Impacted Areas	<p>The SCP section on Potentially Impacted areas, p.10, states that the Liard River exists west of the well site and has an annual flow rate of 2,440 m³/s. It sits more than 1 km away from the well site, but is known to flood and overflow during exceptionally heavy rain seasons, reaching as far inland as the well site.</p>	<p>AANDC recommends that the potential for flooding of the site should be confirmed, and flood mitigation/preparation procedures should be developed if the potential for flooding is real.</p>	<p>Our original submission was incorrect insofar as the proposed location of the geothermal power plant has never been flooded by the Liard River, insofar as records or memories of such events exist.</p>

45	AANDC - WRD	Spill Contingency Plan - List of Hazardous Materials Typically Stored on Site	The fuelling site 400-barrel (18,000 gallons or 68,130 litres) (p. 6) Enviro-Tank appears to be missing from Table 2 - List of Hazardous Materials Typically Stored on Site (p.11) and from Table 4 - Potential discharge event (p. 17). This information should be updated.	The proponent SCP and Waste Management Plan should be updated where appropriate to contain this information.	The Spill contingency plan and waste management plan has been updated as requested.
46	AANDC - WRD	Spill Contingency Plan - Potential Discharge Events	Table 4 - Potential discharge event (p. 17) states "Dry and liquid chemicals" as potential contaminants that could be discharged on site. These "dry and liquid chemicals" should be identified and described individually. If these chemicals differ from the ones outlined in Table 2 (List of Hazardous Materials Typically Stored on Site), Table 2 should also be updated to reflect an accurate picture of all chemicals planned to be stored on site.	Update SCP as necessary	The Spill contingency Plan has been updated to specify all the chemicals contained in the invert mud system.

47	AANDC - WRD	Spill Contingency Plan - Automatic shut off systems	<p>The SCP stipulates under List of Hazardous Materials On-Site, p. 12, that of the maximum 8,000 litres of brine water found in the system at all times, a maximum of 400 litres could spill before the automatic shut-off and bypasses occurs. Automatic shut-in would also limit to a maximum of 400 litres the spill of binary fluids, instead of the 15,000 litres maximum volume in the system at all times. Further information is required on the type of shut-off or shut-in mechanisms utilized. While these systems may be reliable, the proponent should also describe how their reliability over the years will be maintained. Depending on the certainty of the information provided and as even the best mechanical systems sometimes fail under exceptional circumstances, a worst case scenario would represent the total volume capacity.</p>	<p>Proponent to provide additional details on the automatic shut-off and bypass system, such as how it works, how it is monitored, and how it is maintained.</p> <p>Despite presence and use of the shut-off system, spill response procedures should be developed and described in the SCP with respect to a worst case scenario event for release of brine water and binary fluids.</p>	<p>The worst case scenario for geofluid involves two sources of geofluid; subsurface and surface. The surface component of this event relates to a volume of fluid which would leak out prior to next containment valve, thereby relying on these valves to function. Containment valves are activated by a change in pressure on either side of the valve, which activates them to move to a 'locked' position, preventing any flow. The reaction is measured in seconds and full valve closure is accomplished in less than 5 seconds from the onset of a significant change in pressure. Even in disaster scenarios, the valve controls and control panels will remain functional. The worst case scenario for secondary fluid release is entirely dependent on a similar set of valve controls on the binary loop. As defined (elseswhere) this is 400 L. In a similar fashion, the binary loop control valves are activated into a lockout closed position by experiencing an unexpected pressure drop on either side of the valve.</p>
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48	AANDC - WRD	Waste Management Plan - Subsurface site description	The MVLWB Guidelines for Developing a Waste Management Plan suggests in Section 3.1 (g) that description of subsurface characteristics, as well as description of site water management (i.e. flow/drainage patterns) and geotechnical characteristics be included in the Introduction of a Waste Management Plan.	AANDC recommends these details to be added to Borealis Geopower Waste Management Plan.	In response to this query, AANDC-WRD was asked by Borealis to specify what near surface and surface characteristics required description. AANDC undertook to determine what would be required in terms of description for this for this project. At the time of submission, this clarification was not yet received. Accordingly, we are unable to respond at this time.
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49	AANDC - WRD	Waste Management Plan - Management of Each Waste Type	<p>Section 3.3 of the MVLWB Guidelines for Developing a Waste Management Plan (WMP) suggests that the following information be included for waste types that do not require a separate management plan: description of the activities involved in the management (handling, storage, collection, separation, transportation, treatment, disposal, etc.) from generation to disposal. Borealis Geopower specifies on p. 9 of its WMP that all domestic, human, drilling and liquid wastes will be stored and transported off site to approved facilities. The proponent classifies all other wastes as one category "Other wastes" and also states that Beaver Enterprises will ensure that food, domestic wastes and petroleum-based chemicals (e.g. greases, gasoline, glycol-based antifreeze) are kept inaccessible to wildlife at all times.</p> <p>AANDC believes that different waste types should be considered and planned for separately within a WMP (for example, domestic waste and chemicals such as antifreeze should not be grouped together). The proponent should include a description of the source of generation; estimates of the</p>	AANDC recommends that the Proponent revise their Waste Management Plan in accordance with the MVLWB Guidance.	The Waste Management Plan has been updated accordingly.
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50	AANDC - WRD	Waste Management Plan - Location of Waste Management Activities	<p>Section 3.1 (f) of the MVLWB Guidelines for Developing a Waste Management Plan suggests that proposed location(s) for all waste management activities (refuelling, tank transfer site for transport, etc.) should be presented on a map of the operations.</p> <p>Table 2, 3 and 4 of the Spill Contingency Plan provide a list of the of various different wastes planned to be found at the geothermal plant site. Certain types of wastes have their own specific storage location, while other wastes (various tanks, binary working fluid, etc.) may be grouped and stored together, or found at different storage locations.</p>	<p>AANDC recommends that the each waste storage locations should be identified a map of the Geothermal Plant Facility site. Where applicable, locations of significant historical waste management areas (adjacent brownfield) should also be included. Any changes to these locations should be provided in Borealis Geopower's Annual Water Licence Report.</p>	See the Drill Site Layout Map.
51	AANDC - WRD	Waste Disposal	<p>Additional information was provided via email regarding disposal of liquid wastes. It is now the understanding of AANDC that the only liquid waste to be disposed of in the NWT is produced water, and that will be disposed of via re-injection.</p>	<p>AANDC requests that Borealis confirm the method of disposal for all liquid wastes from the project.</p>	<p>Human waste and grey water will be disposed at the Fort Liard Sewage Lagoon. Production Water: re-injected. Drilling Fluid: Sent to CCS Sierra Facility (Ft Nelson). Drilling Solids: sent to CCS Northern Rockies Facility. The disposal path for all liquid wastes related to the project are contained in pp. 9-10 of the Waste Management Plan. Important to note, the geofluid contained within the geothermal power system is not, in and of itself, a waste stream.</p>

52	AANDC - WRD	Re-injection Capability	<p>On February 5, 2012, Borealis GeoPower submitted additional information entitled "Geological Analysis on Re-injection for Fort Liard Geothermal Project." Within that document, it is stated that the Mattson formation has been used in the past for re-injection. Several examples were provided.</p> <p>For several examples it states that full injectivity tests were completed for the well. How are these tests performed and how is it determined that the formation is suitable at that specific location for re-injection (considering that the thickness of each zone will vary?). Are there specific criteria against which the results are evaluated?</p>	<p>AANDC recommends that Borealis to provide additional information for review.</p> <p>AANDC recommends that Borealis conduct a "full injectivity test" to ensure that the proposed geological formation is suitable to receive re-injected waters from this project.</p>	<p>The injectivity test is a procedure conducted to establish the rate and pressure at which fluids can be pumped into the treatment target without fracturing the formation. Subsurface logging tools will be run on the completion of the production well to determine the Mattson reservoir conditions including permeability, pressure and flow environment. This logging program will also confirm the permeability of the overlying shale cap rock. The National Energy Board currently evaluates the suitability of Oil & Gas re-injection wells in the Northwest Territories. They do so on a case by case assessment of the overall geologic environment rather than relying on specific criteria. Borealis is following a similar evaluation process to that employed by the National Energy Board.</p>
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53	AANDC - WRD	Re-injection	<p>On February 5, 2012, Borealis GeoPower submitted additional information entitled "Geological Analysis on Re-injection for Fort Liard Geothermal Project." Within that document, it is stated that the "low permeability" Garbutt formation and Fantasque formation sit on top of the Mattson formation, where re-injected water will be deposited. The term "low permeability" has not been quantified. Please quantify this term.</p> <p>Further, the document states that "These low permeability caps above our intended injection formation are expected to be thick enough to by far withstand any injection pressures induced by the injection." What would be a minimum thickness required? If further information is required to answer this question please identify information requirements.</p>	AANDC recommends that Borealis to provide additional information for review.	<p>As stated in our response to query #52, assessment of pressures within the Mattson formation and the confirmation of the permeabilities within Garbutt Shale formation can be completed with subsurface logging tools following the drilling of the production well. Permeability (commonly symbolized as κ, or k) is a measure of the ability of a porous material to allow fluids to pass through it. A value of 0.1 mD (millidarcies) is considered to be impervious and capable of acting as gas cap (with no gas or water movement into the above formation). The significant thickness (140m) of this shale formation contributes to the overall integrity of the strata to act as a caprock. Further, the Mattson extends horizontally throughout the Fort Liard Basin.</p>
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54	AANDC - WRD	Re-injection reservoir	<p>On February 5, 2012, Borealis GeoPower submitted additional information entitled "Geological Analysis on Re-injection for Fort Liard Geothermal Project." Within that document, it is stated that "These low permeability caps above our intended injection formation are expected to be thick enough to by far withstand any injection pressures induced by the injection."</p> <p>Is it simply not possible for re-injected fluids to migrate through these overlying formations or is the rate of movement so low that it would take an extended period of time to migrate through? If the former, provide a detailed explanation. If the latter, provide details on the time for fluids to migrate through these formations.</p>	AANDC recommends that Borealis provide additional information for review.	Based on the assessment of permeabilities with the Garbutt Shale, it is not anticipated that re-injected formation fluids will be able to propagate through this zone. See #53 for reference on impervious permeability definition.
55	AANDC - WRD	Well Design	<p>On February 5, 2012, Borealis GeoPower submitted additional information entitled "Geological Analysis on Re-injection for Fort Liard Geothermal Project." Within that document, it states that the well design will conform to all required specifications as per NEB "Drilling and Production Guidelines" and/or the ERCB "Director 008 Surface Casing Depth Requirements."</p>	AANDC recommends that Borealis provide additional detail on the requirements which will be used for this project. What will be the surface casing depth for this project?	Casing depth for the production well is ~500m for the production well and ~365m for the injection well. See attached Codeco document for more complete well design.

56	AANDC - WRD	Duration of Re-injection	<p>It is stated that the project could last for 310 years. Should this occur, it is assumed that re-injection will be conducted for 310 years. Please confirm.</p> <p>Is the subsurface reservoir capable of handling 310 years of re-injected fluids?</p>	<p>AANDC recommends that Borealis provide information on the duration of re-injection, volumes predicted, and capacity of the re-injection reservoir, should the project last for 310 years.</p>	<p>See updated Spill Contingency Plan.</p>
57	AANDC - WRD	Drilling Process	<p>On February 5, 2012, Borealis GeoPower submitted additional information entitled "Geological Analysis on Re-injection for Fort Liard Geothermal Project." Within that document, it states hydraulic fracturing will not be used in the project but that acid stimulation may be used.</p>	<p>AANDC recommendst that Borealis confirm that hydraulic fracturing will not be used in this project. Provide additional detail on the process of acid stimulation, whether it will it be used for both wells, the quantities of acid required and how it will be stored and handled on site.</p>	<p>It is confirmed that hydraulic fracturing will not be used on this project. Acid stimulation refers to a process where an organic acid is injected into a well bore for the purposes of cleaning any blockages from pore throats by the drilling mud and also to expand the effective surface area of the borehole. Acid selection depends on a number of factors, most important of which are the rock composition and bottom hole temperature. At Ft. Liard, its likely that a formic or acetic acid, with a corrosion inhibitor, will be deployed to clean the borehole and increase the surface area. Acid stimulations take 3-4 days to complete and require 3,000-4,000 m3 of fluid (water, acid) which is typically mixed into a weak acidic solution (5-15% acid)</p>

58	AANDC - WRD	Drilling Process	It is expected that there will be a high water/gas ratio shortly after establishment of the development well. Will gas be initially produced in high volumes until water coning occurs? How will this gas be handled?	AANDC recommends that Borealis provide additional information for review.	There is no anticipated free gas in this geological environment, however to accommodate the possibility of small gas production in the system Borealis has sourced a viable separation, storage and tanking solution. "CanGas Solutions is a North American leader in the development and utilization of containerized natural gas transport." http://www.cangassolutions.com/
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59	AANDC - WRD	Reclamation Security	<p>AANDC has prepared a RECLAIM cost estimate for costs associated with the reclamation of this project. This estimate is based on recent experience capping abandoned wells near Hay River. A total liability of approximately \$1.78 M has been estimated, and details are included in the attached spreadsheet.</p>	<p>AANDC recommends that MVLWB set reclamation security within the water licence at \$1,782,739.00</p>	<p>While Borealis recognizes the need for security, vis-à-vis reclamation, we dispute the value forwarded by AANDC-WRD. We expect that abandonment will occur only in the event that the first well drilled, the production well, does not have the mooted attributes sufficient to sustain viable electricity production. In that event, the well would be abandoned in accord with standard Oil & Gas practices and in accord with any locally applicable legislation. However, in this context, there is only one well and no mobilization/demobilization costs, which suggests a reclamation cost of \$566,369, using AANDC's own figures. Should the project move to power production, it will be majority owned and operated by NTPC, a crown corporation, from which AANDC does not require security deposits.</p>
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60	SJ Geophysics (for MVLWB)	Acid Stimulation	<p>In the event that the Nahanni formation is encountered in Borealis' drilling program and it is found to have insufficient permeability, there are options to try to enhance the permeability. Borealis alludes to this in the application materials in which it is stated that proposed operations will include "potential acid stimulation". The Nahanni formation is dominantly limestone and this is a rock type which reacts readily with acid and dissolves. Acid stimulation is a method used in the geothermal industry to try to increase permeability by pumping acid down a well to dissolve the host rock in the geothermal reservoir to increase the interconnectedness of vugs and cracks.</p>	<p>Information from Borealis on the potential acid stimulation program and expected permeability improvement would be useful to evaluate this back up plan in case sufficient natural permeability is not encountered.</p>	<p>There is a broad history of acid stimulation on geothermal wells. However, the bulk of these have been performed on aging wells that have significantly impaired production. Accordingly, the improvements seen on these wells, which range between 50% to 450% increased flow, cannot be used as the basis for comparison. On a new well, it is expected that acid stimulation could increase the initial permeability by 5%-70%, depending on the damage to the formation caused by drilling and the overall efficacy of the acid/rock interaction.</p>
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61	SJ Geophysics (for MVLWB)	Calculation of electricity generated	<p>The Geological & Geothermal Energy Resource Assessment report by Borealis Geopower (included in the application materials), states that 160 °C geothermal fluids flowing at 25 litres/second can be expected to generate 880 kW of electricity. Based upon analogous geothermal power production efforts elsewhere (e.g. Soultz-sous-Forêts in France) the proposed generation capacity appears reasonable, considering the stated temperature and flow rate. However, the actual calculation showing how 880 kW was obtained was not provided in the LUP and WL application materials.</p>	<p>A more complete description of the electricity generation calculation would be useful.</p>	<p>The calculation of net power generated is the result of significant computer modelling and comprises literally hundreds of individual computations relying on a host of assumptions. In our opinion, it is not practically possible to provide the full calculations. We believe that the best mechanism for disclosing this information is a graphical representation of the plant, operating under maximum flow conditions, based on 3rd party verified simulation. This has been provided as submission "Graphical Response to Query 61."</p>
62	SJ Geophysics (for MVLWB)	Drill plan	<p>As an integral part of the planning and preparation of a drill program, detailed drill plans are commonly drawn up that describe the intended well design, drill rig specifications, safety procedures and other important aspects of the drilling operation. The LUP and WL application materials do not appear to contain a drill plan or borehole diagrams for the proposed production and injection wells.</p>	<p>It is recommended that these documents are prepared by Borealis and then reviewed by an independent drilling expert before the commencement of the drill program.</p>	<p>Borehole diagrams are provided from CODECO Energy Group and full drilling program has been initially developed but is not yet complete. This is to be expected as drilling programs are often developed in conjunction with the driller, who has yet to be selected for this project. A full drilling program will be completed prior to drilling.</p>

63	Hemmera (for MVLWB)	Impacts and Mitigations	The organization of the WL and LUP applications and EA document is confusing, as impacts, mitigations, and recommendations occur throughout the documents as opposed to a dedicated section with a consolidated list. Potential impacts and mitigations described in the Spill Contingency Plan and Waste Management Plan are not stated in the WL or LUP applications. It is unclear whether the proponent intends to recognize the potential impacts and mitigations outlined in the EA documentation, as many were not included in the WL or LUP applications, and the proponent did not author this document.	Hemmera recommends that the proponent consolidate all potential mitigations and impacts mentioned in their WL and LUP application package. Effort should be taken to avoid repetition, and also order both impacts and mitigations by Project phase.	To the degree that this is possible, efforts have been made to reduce duplication. However, as the WUP & LP application individually request similar information, we cannot avoid some levels of duplication without submitting incomplete applications.
64	Hemmera (for MVLWB)	Transmission lines and substations	There is no transmission line or substation included in the Project description. The additions of these project components are relevant to both the construction and operation phases of the Project, and could impact environmental components depending on their location. Potential impacts associated with the transmission line and substation construction and operation include: vegetation loss, wildlife habitat loss or alteration; sedimentation and erosion into surface waters; changes to natural hydrological regimes.		No separate transmission or substation is required for this project, as the power generation plant has been designed to provide the system requirements and therefore can be simply directly connected to the grid.

65	Hemmera (for MVLWB)	Species at Risk	Wood frogs are likely to be present on the Project site, and there is also the potential for western toad. Western toads are a species at risk and are protected under Schedule 1 of the Species at Risk Act. The NWT also ranks the western toad as a species that May Be At Risk, under its General Status Program (ENR 2012). Clearing and brushing, and the creation of a cooling pond associated with project activities can result in habitat loss and alteration to amphibians on site. The cooling pond has the potential to attract amphibians in search of a breeding site, but may ultimately act as a habitat sink (an important source of mortality if egg masses or tadpoles are less likely to survive under cooling pond conditions).	In order to limit habitat loss to wildlife species including amphibians, mitigation measures to minimize the Project footprint should be implemented. Accidental encroachment into areas not required for the Project can be minimized by clearly marking the extent of vegetation clearing on plans and in the field. Mitigation measures such as exclusion fencing for amphibians around the cooling pond could act to reduce amphibian mortality.	As per the responses to queries # 4, #14, #15, and #18, to the degree that we are able, we are trying to both minimize the project footprint and the impact that has on the proposed site. Further, as per our response to #30, we are no longer permitting the option to have a cooling pond, and thereby have greatly reduced our footprint vis-à-vis local amphibians et al.
66	Hemmera (for MVLWB)	Increased Risk of Mortality for Wildlife	Planting of agronomic grasses during reclamation could attract bison and other large mammals including ungulates and bears to the site, and increase the likelihood of human-wildlife interactions which could result in wildlife mortality.	Mitigation measures to exclude large animals from the Project site should be considered. Such measures should include exclusion fencing around the site boundaries, fence maintenance over the life of the project, gating the site and developing some gate protocols to reduce the likelihood of bison or other large mammals gaining access to the site.	This has been covered in our Environmental Site Assessment and is included in our plant design.

67	Board staff	Location coordinates	<p>There is a discrepancy in the coordinates provided in Sections 3 and 4 of the WL application, Section 5 of the LUP application, and Figure 3 of the Project Summary. Additionally, the maximum and minimum coordinates provided in the LUP application (Section 16) are very broad compared to what appears to be required in Figure 3.</p>	<p>Clear, correct coordinates (including appropriate maximums and minimums) must be provided for the project.</p>	<p>These have been updated and are included in our revised submissions.</p>
68	Board staff	Fuel volume	<p>The tank described in the Spill Contingency Plan under Contingency Planning, Item 2, is an 18,000 Enviro-tank with a bermed area with 150% holding capacity. In the LUP application and in Table 2 of the SCP, a 10,000 L tank and 5,200 L tank are described for the well-site, and the holding capacity of the bermed areas is 110%. Table 4 in the SCP then described leaks from 200L drums. It is entirely unclear how fuel will be stored on site and how much fuel will be on site.</p>	<p>Clarify the volume of fuel to be stored on site; the type, size and location of the tanks; and the capacity of the bermed area(s).</p>	<p>See updated spill contingency plan.</p>

69	Board staff	Potential acid stimulation	This is only referenced in the list of steps for project.	Further information is required on the purpose, the procedure, the chemicals used, and the potential impacts of acid stimulation.	Please see our responses to queries # 57 and #60. Further, the chemicals used are included in the updated Spill contingency Plan. The potential impact of acid stimulation on a new well is to improve permeability and by 5-70%, depending upon initial damage to the formation and the efficacy of acid interaction with production formation. Acid stimulation involves circulating large quantities of weak acid for a period of 3-4 days.
70	Board staff	Water use for drilling.	If water is needed for drilling, it will be sourced from the Liard River. How much water is estimated to be needed for drilling if this method is used?	Please clarify.	We estimate that a maximum of 1,000 m3 of water would be used in drilling.
71	Board staff	Cooling Pond	Different measurements are given for the size of the cooling pond.	Please clarify the expected size of the cooling pond.	As per our response to query #30, we are no longer permitting the option to have a cooling pond
72	Board staff	WMP - Brush and Trees	How will any cleared brush and trees be disposed of by Beaver?	Please clarify.	Beaver Enterprises indicates that trees with timber value will be sold as logs, smaller yet substantial wood waste will be cut and stacked for local use in heating, and that the remaining brush, branches, and wood waste will be piled into slash piles and burnt when permitted under local fire regulations.

73	Board staff	WMP - Hazardous wastes	While it is clearly Borealis' intention to remove almost all of the waste to an approved disposal site outside of the NWT, and to have Beaver conduct the waste storage and removal, Borealis is still responsible for the waste produced, stored, and removed from the site. Hazardous wastes must be managed, stored, and transported according to applicable legislation.	The Waste Management Plan should demonstrate how the management of hazardous waste complies with applicable legislation.	The updated Waste Management Plan speaks directly to the containment, transport, and disposal of hazardous waste generated during the drilling and operating segments of the project.
74	Board staff	SCP - General	This plan will need to be revised to be specific to plant operation once drilling is complete.	To be included in WL Conditions (for Board).	The updated Spill Contingency Plan takes into account both drilling and ongoing operations.
75	Board staff	SCP, Introduction - Existing Preventative Measures	The existing preventative measures are described under General Protections Measures and Contingency Planning sections. As it stands, this section only describes the definition of a spill and summarizes the Action Plan, so the title of this section is either incorrectly applied or misplaced.		The updated Spill Contingency Plan incorporates these edits.
76	Board staff	SCP, Introduction - List of Hazardous Materials	Grey water will be contained on site and then transported off-site for disposal outside of the NWT. Based on the application package, the grey water will also contain toilet waste and possibly liquid drilling waste. A spill of this mixture could potentially occur during the storage period and should be addressed in this plan.	Please indicate the volume and location of the storage tank in Tables 3 and 4, and include this potential source in the Action Plan.	The updated Spill Contingency Plan incorporates these edits.

77	Board staff	SCP, Introduction - List of Hazardous Materials	Where will DOW be stored? Some information on DOW storage is provided in the section on potential impacts of spills, and a bermed area is mentioned, but it is not clear where this bermed area will be.	Please clarify where the DOW storage area will be.	The updated Spill Contingency Plan incorporates these edits.
78	Board staff	SCP, Introduction - List of Hazardous Materials	Where will cement and drilling chemicals be stored?	Please clarify.	The updated Spill Contingency Plan incorporates these edits and shows their position.
79	Board staff	SCP, Tables 2 and 3 - General	The presentation of these tables is confusing. In the Capacity of Containers column in Table 3, some volumes listed are the amounts to be stored on site, and some are the potential spill volumes that could be expected.	Only one table is required for this section. The table should list the types and volumes of each hazardous material used and stored on site. Potential spill volumes are covered in the Action Plan Section (currently Table 4).	The updated Spill Contingency Plan incorporates these edits.
80	Board staff	SCP, Table 3 - Binary Working Fluid	Where does 150L come from? In the text beneath the table, the total volume of binary fluid in the system is 15,000L, and the maximum leakage volume (before automatic shut-off) is 400L.	Clarify the maximum volume of a possible binary fluid leak. Please note that the total volume stored on site should be presented in Table 3. The potential spill volume should be covered in the Action Plan Section (currently Table 4).	The maximum leakage volume is confirmed at 400 L; updated Spill Contingency Plan incorporates these edits.

81	Board staff	SCP, Table 3 - Uncontrolled gas/water flow	Would well blowout only be a potential issue during drilling, or would this be an on-going concern during operation of the power plant?	Please clarify.	The entry in Table 3 was meant to only highlight the increased risk of loss of well control when the secondary backup, notably the Blow Out Preventer (BOP), is being changed out to the permanent well head. Generally speaking, with both mud systems and a BOP, the redundant systems eliminate the risk of loss of well control. For ongoing operation, there is no risk of loss of well control while the permanent well head is in place.
82	Board staff	SCP, Figure 4 - Flow chart of Response Organization	Where is the Incident Response Matrix associated with a Level 1 Alert?	Please clarify.	The updated Flow Chart of Response Organization incorporates these edits.
83	Board staff	SCP, Figure 4 - Flow chart of Response Organization	The full sequence of events from the start of the incident until the spill is contained are not outlined, so it is difficult to correlate this flowchart to the action plan and understand who is responsible for each step.	This flowchart should be revised to summarize the full sequence of events and identify the responsible parties.	The updated Spill Contingency Plan incorporates these edits.
84	Board staff	SCP - Procedures for Containing and Controlling the Spill	Items 6-8 in this section seem out of place and relate more to waste management practices. While some of these waste management practices may apply to the wastes generated from spill clean-up, this section is not written in a way that addresses spill wastes, and in any case, is presented out of sequence.	Please revise these sections accordingly.	The updated Spill Contingency Plan incorporates these edits.

85	Board staff	SCP - Procedures for Containing and Controlling the Spill	Under Item 6, Waste Disposal, remote fuel caches are referenced. No remote fuel caches are identified in the project applications.	The reference to remote fuel caches should be removed.	There will not be a remote fuel cache. The updated Spill Contingency Plan incorporates these edits.
86	Board staff	SCP - Procedures for Containing and Controlling the Spill	Under Item 7, Used Container Disposal, scrap metal is to be flown off-site for disposal. It seems unlikely that scrap metal would be flown off-site from a site with road access.	If incorrect, this reference should be removed.	The updated Spill Contingency Plan incorporates these edits.
87	Board staff	SCP, Table 4 - Binary Fluid	Binary fluid is not included in this table.	Include binary fluid in Table 4.	The updated Spill Contingency Plan incorporates these edits.
88	Board staff	SCP, Table 4 - Well blowout	Uncontrolled gas/water flow from a well blowout is included in Table 3 as a job-specific hazardous material, but not in Table 4 as a potential spill.	This source should be included in Table 4 as a potential discharge, rather than in Table 3, since it is not a material stored on site.	The updated Spill Contingency Plan incorporates these edits.
89	Board staff	SCP, Action Plan - Gasoline	No gasoline is to be stored on site, and it is not listed in Table 4, but a worst-case scenario describing the puncture of all drums is described.	The scenario for gasoline should be removed or revised to represent the situation on site.	The updated Spill Contingency Plan incorporates these edits.
90	Board staff	SCP, Action Plan - Salt/Formation Water and H2S	Why are Salt/Formation Water and H2S described with no worst-case spill scenario? This is inconsistent with the other spill sources described in this section.	The worst-case scenario and potential impacts should be described for a spill of salt/formation water and for a release of H2S.	The worst case scenario for a geofluid spill has been developed as part of the response to query # 35. The worst case scenario for a H2S release has been developed in accord with the BEHR study on H2S plumes.

91	Board staff	SCP, Action Plan - Potential Environmental Impacts of Spills	The sections on Fuel and General Chemicals Spills, Well Kick, and On-site/Off-site Waste Disposal all describe existing preventative measures and are out of place in this section of the document. This section should describe the worst-case scenarios and potential environmental impacts of spills from all potential sources on the site.	The information provided in these sections would fit better in the section on general/existing preventative measures.	The updated Spill Contingency Plan incorporates these edits.
92	Board staff	SCP, Appendix 4 - MSDS	No MSDS is presented for the binary working fluid.	Please provide one.	As per our response to query # 28, MSDS sheets for R245FA have been added to the Spill Contingency Plan.
93	Board staff	SCP, Appendix 4 - MSDS		MSDS for drilling additives and chemicals must be provided once the drilling method has been finalized.	MSDS sheets for the additives to invert mud (& acid stimulation chemicals) have been added to the Spill Contingency Plan.