REPORT 2016-07 (Section A)

CONTRACT 2015-22

Direct-use Geothermal Resources in British Columbia

Fairmont Hot Springs

TUYA TERRA GEO CORP. &
GEOTHERMAL MANAGEMENT
COMPANY INC.

5/5/2016

REPORT 2016-07

SECTION A

SUMMARY OF FINDINGS

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NOTE REGARDING APPENDICES: Personal contact information was obtained for the purpose of this project and presented in Appendices B and E. Due to this private content, these appendices are not included in full as part of the published report but will be on file with Geoscience BC.

COVER: View looking east at the Fairmont Hot Springs' pools (site visit Lund, 2003).

LIST OF TERMS AND ABBREVIATIONS

BC	Province of British Columbia
CIHR	Canadian Institutes of Health Research
Direct-use	also referred to as, Direct-use geothermal energy, Direct-use applications, geothermal Direct-use, Direct-use geothermal resources, Direct-use geothermal developments
FNCEBF	First Nations Clean Energy Business Fund
GDDM	Geothermal Development Decision Matrix
GHGE	Green House Gas Emissions
GMC	Geothermal Management Company Inc.
ICE Fund	Innovative Clean Energy Fund of British Columbia
KWL	Kerr Wood Leidal Associates Ltd.
Mt.	Mount (i.e. Mt. Cayley)
MWe	Megawatt electrical (measure of electrical generation capacity)
MWt	Megawatt thermal (measure of heat capacity)
NSERC	Natural Sciences and Engineering Research Council of Canada
Project	The topic of this report, Geoscience BC Project 2015-22, 'Direct-use Geothermal Resources in British Columbia'
OCP	Official Community Plan
Roadmap	'The Roadmap for Development of Geothermal Direct-use Projects in British Columbia, Canada' (a separate document that accompanies this report)
SSHRC	Social Sciences and Humanities Research Council of Canada
TAC	Geoscience BC's Geothermal Technical Advisory Committee
TT Geo	Tuya Terra Geo Corp.
UBCM	Union of BC Municipalities

EXECUTIVE SUMMARY

Tuya Terra Geo Corporation (TT Geo), a BC-based company, working in collaboration with Geothermal Management Company Inc. (GMC) and their respective teams, were retained by Geoscience BC in September 2015 to identify and evaluate Direct-use geothermal energy opportunities for BC communities, providing them with data and an opportunity to potentially lower greenhouse gas emissions and advance economic development through the use of geothermal energy.

Previous studies of Direct-use geothermal energy in British Columbia (BC) have focused on the end-use application or have been specific to locations or projects. Most recently, the study by Kerr Wood Leidal Associates Ltd. (KWL) and GeothermEx (2015) evaluated 18 geothermal sites (Figure 1) and provided more detailed economic information for 11 of those sites deemed 'favourable' for electrical generation. This study builds on the results of KWL and GeothermEx (2015) by seeking to evaluate the potential of Direct-use geothermal in BC communities from a resource, community capacity and development-potential perspective.

Direct-use geothermal developments can typically utilize lower temperatures waters than required for electrical generation. These lower temperature fluids are more easily attainable with simpler, lower cost exploration strategies in a much shorter time frame than electrical generation development (Figure 2). Additionally, the exploitation of these low temperature geothermal resources can have significant economic benefits for communities. Experience in Iceland has shown that employment from the direct-use applications of geothermal waters exceeds those of electrical generation by a factor of 10 to 1 (GEKON, 2011; Albert Albertson, personal communication, 2016). However, communities and local governments may not have access to the expert knowledge required to oversee a geothermal resource exploration program, or the cost of exploration may be a major barrier to wider adoption of Direct-use geothermal energy. The initial contact proved that few communities have the expertise to evaluate their geothermal potential; and even fewer had considered geothermal in their community planning.

The purpose of this project was to first identify and evaluate Direct-use geothermal energy opportunities for BC communities that have the potential to reduce green-house gas emissions or be economic development drivers. To do this, a review of various Direct-use development possibilities was undertaken and compiled as applicable to BC. The gathering of detailed community information focused on the 11 sites deemed 'favourable' for electrical generation in the KWL and GeothermEx 2015 report. A list of communities associated with these sites was compiled under the assumption that if there was a resource sufficient for electrical generation, then Direct-use (with its lower hurdles to development) was possible. A total of 63 communities were contacted and provided with information about their nearby resource. In this process, the Project sought to give communities and businesses in BC an understanding of what resources are available and what steps they need take to evaluate these geothermal resources. This study did not evaluate the use of heat pumps for ground based geothermal (geoexchange).

The study was divided into three phases that included the following:

Phase 1: Work identified geothermal sites and communities in BC with potential for Direct-use geothermal energy development (using the 11 sites deemed 'favourable' by KWL and Geothermex

(2015) as a base). This process entailed the compilation of publicly available geoscience data, updating BC's heat flow map and BC's hot spring geochemistry database (Figure 1 and 3), the engagement of communities through a survey questionnaire (Figure 3), follow-up interviews, and the refinement of a Geothermal Development Decision Matrix (GDDM) to evaluate and rank the potential Direct-use sites.

Phase 2: The engagement processes were designed to build community-research capacity and to increase communities' awareness and knowledge of geothermal resources in their region. This involved a review of the community plan and technical information gathered for the favourable geothermal sites, the dissemination of an information package and survey questionnaire to the communities identified during the first phase, follow-up correspondence with the communities, and the finalization of the weighting factors required for the GDDM in order to systematically evaluate the sites and the associated communities.

Phase 3: This entailed summarizing and analyzing the community engagement process undertaken in the first phase, reviewing and harmonizing the Geothermal Development Decision Matrix results, and completing 'The Roadmap for Development of Geothermal Direct-use Projects in British Columbia, Canada' (the *Roadmap*).

Results

It was quickly ascertained that very few communities had any knowledge of their Direct-use geothermal development potential. Team members spent a significant amount of time with a number of the communities providing them with the currently available information. Due to the sparsity of data made available by the communities to the project, no economic analysis was completed for the communities. An assessment of the communities was carried out through the GDDM and communities ranked from more favourable to less favourable.

Weighting factors used in the GDDM were based on an analysis of the developability of an area using available data. The weighting factors used were biased towards a likely resource with temperatures between 40–80°C (or higher) and a receptive community. Favourability (low, moderate, and high) values were assigned based on the weighted ranking. 'High', 3.00 and above; 'moderate' between 3.00 and 2.50 and those below 2.50 were assigned a 'low'.

The main problems encountered in the project were 1) the lack of ability of the communities to respond to the questionnaire, 2) our ability to engage the community in more in-depth discussions within the scope of the project and 3) the challenge of just getting a response from some communities. This made an economic analysis impossible as there were no constraints on the type of development that might be feasible in a community. To compensate for the lack of primary information collected from the communities, secondary information from alternative sources was collected and used in the GDDM.

Deliverable Documents

The Direct-use Geothermal *Roadmap* embodies the information needed by the communities to assist them in pursuing geothermal projects for economic development and greenhouse gas emissions (GHGE) reductions. This document, along with the resource information gathered by KWL and GeothermEx (2015) and updated by ourselves as part of the GDDM, is crucially important in assisting Communities. Most of the updates to the GDDM data were done in Section H of this report, broadly named 'Community Issues'. A summary of the community responses and a contact list of communities is also

provided, but due to the sensitive nature of some of the responses and the provision of contact information, the appendices contain only a summary of the information. Geoscience BC can be contacted directly for the full appendices. The GDDM summarizes the status of Direct-use development potential in BC.

Conclusions

There are significant areas of BC that would benefit from Direct-use geothermal applications. Direct-use geothermal applications could help communities lower their GHGE, increase economic development and enhance their quality of life through recreational use. However, more community involvement, technical knowledge and support will be required before most communities can move forward on Direct-use development projects. Few communities had considered additional uses for the geothermal fluids, even those communities with an operating swimming/spa facility. The exception was the village of Valemount. This community is at an advanced stage in planning for geothermal Direct-use applications. The community has had meetings and workshops to build a plan and to broaden consensus on the development of nearby geothermal resources. The village of Valemount has now provided a model for other communities wishing to investigate Direct-use potential applications in other regions.

In 2007, the Province, the Union of BC Municipalities (UBCM), and local governments agreed, through the Climate Action Charter, to collectively take action on climate change by reducing greenhouse gases. The Greenhouse Gas Reduction Targets Act (2007) sets a province-wide reduction target of 33% from 2007 levels by 2020. Many communities have an Official Community Plan (OCP) that includes GHGE reduction targets. Some communities, for example Terrace, have even more ambitious targets than those stated in the Charter, but few have made significant progress on reducing GHGE through Direct-use geothermal resources that might be in close proximity. The municipalities need assistance assessing and creating an action plan that includes geothermal energy. In 2008, new legislation was passed that requires every community to have a stated GHGE reduction target.

In addition to GHGE reduction targets that might lead to the use of geothermal energy through Direct-use development, there is a growing international trend in spas and indigenous healing practices (http://www.spafinder.com/blog/trends/2016-report/). British Columbia's slogan 'Super Natural BC' and these new trends are highly aligned. Natural resorts centered around a wellness theme, natural hot spring waters and First Nation's cultural healing practices could be a winning combination for some communities. Remoteness is one drawback to mass appeal, but clever and targeted marketing of 'circle tours' and 'fly-in fly-out' access might appeal to clients in a higher financial echelon, especially if coupled with hiking, wildlife and bird watching, fishing and other outdoor recreational pursuits.

Direct-use geothermal resources presents opportunities for family oriented activities to meet the needs of a 'rising generation of children who are stressed, anxious and overwhelmed at unprecedented and alarming levels' ('Parenting Well: Serious Spa & Wellness for Kids'), and adults who are suffering the effects of a hyper-connected workplace, demanding hours, and sedentary habits ('Workplace Wellness Wakes Up')' according to information from Spafinder Wellness 365 (January 12, 2016). At least one BC location, near Ainsworth Hot Springs, has already pursued this targeted audience seeking increased wellness (http://www.mountaintrek.com/).

In addition to family-oriented activities there are increasing concerns over 'nature deficit disorder' in young people. This disorder is the focus of a number of scholarly articles (c.f. Kuo, 2006 and Lauv 2008,

2010) and is being championed by such notables as artist Robert Bateman http://www.gicel.ca/2011/robert-bateman-interview-about-nature-deficit-disorder/ .

If hot spring resort locations can align themselves with these emerging values and market aggressively to local and foreign clients, development may make economic sense. In addition to the obvious spa development, use of the hot water can be extended to heating of buildings and food production through green houses to service the visiting clientele.

In Iceland the 'Resource Park' concept is well developed and deployed around both their low and high temperature resources. The philosophy around this concept is to use all available energy (in the form of heat) in the geothermal fluid. What this means is that when developing a spa, wellness center and/or health resort based on the geothermal fluids these same fluids are also used for space heating as well as other supportive developments. These other developments could be greenhouses needed to service that core development. In Iceland, the Reykjanes Resource Park, has at its core two electrical generation plants, but supports a variety of other industries. The power facilities employs 62 people, but the other industries, using the heat resource, employ more than 600 people (Albert Albertson, personal communication, April 2016; GEKON, 2011).

In addition to the emphasis on 'wellness', there is a global trend focusing on locally grown food. Spurred in part in the Pacific northwest by the '100 Mile Diet' (Smith and Mackinnon, 2007) access to locally sourced food may become an important determiner when consumers make decision about which spas or towns to visit. Greenhouses supplying the local population with local produce may contribute to increasing the quality of life for inhabitants as well as expanding the economic base of the town through an expanded workforce beyond what would be employed in a core facility such as a spa.

In 2011 the BC Government created the First Nations Clean Energy Business Fund Project (FNCEBF). Between 2011 and May 2015, $6,814,645 was invested in First Nations' communities to evaluate clean energy options. Most of the work and funding went into small scale hydro projects and skills training of First Nations', but equity funding (up to $500,000) is also available for First Nations' projects. A listing of funded projects can be found at http://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/consulting-with-first-nations/agreements/fncebf_projects_approved_-_2015-09-14.pdf.

The initiative has the stated objective of providing 'funding to assist with clean energy project feasibility studies, community energy planning or engaging with project proponents'. The information goes on to state that 'Funding will be provided to enable an applicant to engage with project proponents, including undertaking financial analysis of potential projects prior to taking equity positions in a project and reviewing development potential within their territories.' Up to $50,000 is available per eligible applicant as well as the potential equity funding up to $500,000.

(http://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/consulting-with-first-nations/first-nations-clean-energy-business-fund)

In the 2016 budget, the Prime Minister announced a $10,700,000 allocation for the implementation of renewable energy projects in off-grid Indigenous and Northern communities. This allocation is effective from 2016.

In conclusion, each community represents a unique set of circumstance related to their population, climate, vegetation, geography and geology. Due to these variables insufficient data was available to carry out site specific economic analysis, but initial contacts with communities and exposure to the possibilities of geothermal development possibilities was positive.

The GDDM provides a high level ranking of communities that will help focus future efforts. Even those communities deemed to have high favourability for Direct-use development require additional follow-up in order to implement and use the *Roadmap*. Once communities have narrowed the scope of possibilities to projects that might work for them, then an economic evaluation of the specific project(s) chosen can be undertaken.

Recommendations:

1. Regional workshops held in northern, central, southwestern and southeastern BC are critical. These workshops would introduce communities to the potential resources that are available and what they might be utilized for. Copies of the *Roadmap*, GDDM and other resource material should be supplied to attendees. They would be provided with guidance as to the variety of possibilities for Direct-use geothermal and how to work out a basic financial model and economic development plan. These regional workshops should then be followed-up with community workshops where a hands-on development framework could be created. Part of the workshop structure could include a system put in place to:
    a. Raise awareness of the local communities to the presence and benefits of geothermal energy as a heat source.
    b. Providing educational activities to the general public and to school educators about geothermal Direct-use applications.
    c. Providing strategies for increasing local infrastructure development that would boost the local economy and may also provide a positive factor for the economic evaluation of particular Direct-use applications.
    d. Partnering with local community leaders to spread useful and factual information about the advantages of Direct-use applications.

2. First Nations' should be encouraged to apply for funding through the FNCEBF to help in preliminary assessment of their region and evaluate Direct-use geothermal options. Other communities should seek financial assistance through the Province's Innovative Clean Energy fund (ICE), the Economic Development Capacity Building fund, and the new federal funds announced in the budget which would be available through Indigenous and Northern Affairs Canada. For northern communities, the links are through:

    http://www.northerndevelopment.bc.ca/news/innovative-clean-energy-fund-now-accepting-proposals/, and http://www.northerndevelopment.bc.ca/funding-programs/capacity-building/economic-development-capacity-building/.

3. A model for creating carbon offsets by using geothermal heat to diminish reliance on both electric and propane sourced heat should be considered. The model would allow those who retrofit or install new geothermal heat facilities to calculate the lowered demand for fossil fuel derived heat (comfort and cooking as well as some industrial uses) and apply to the Province for either a credit that could return some fraction of the carbon tax collected by the Province or to apply for subsidized loans to develop local infrastructure and facilities.

4. Putting a plan in place to partner with local governments and ultimately the Provincial government to implement a province-wide program using, for example, the US Geothermal

Technologies Program (part of the US Energy Efficiency and Renewable Energy division) as a potential model.

This project was jointly funded by Geoscience BC and the BC government's ICE Fund. Geoscience BC is a non-profit organization supported by the Province of British Columbia that generates earth science information in partnership with First Nations, the resource sector, universities, governments and communities to encourage investment and enable informed land use decisions for the benefit of all British Columbians. The ICE Fund is a Special Account, funded through a levy on certain energy sales, designed to support the Province's energy, economic, environmental and greenhouse gas reduction priorities, and to advance B.C.'s clean energy sector.

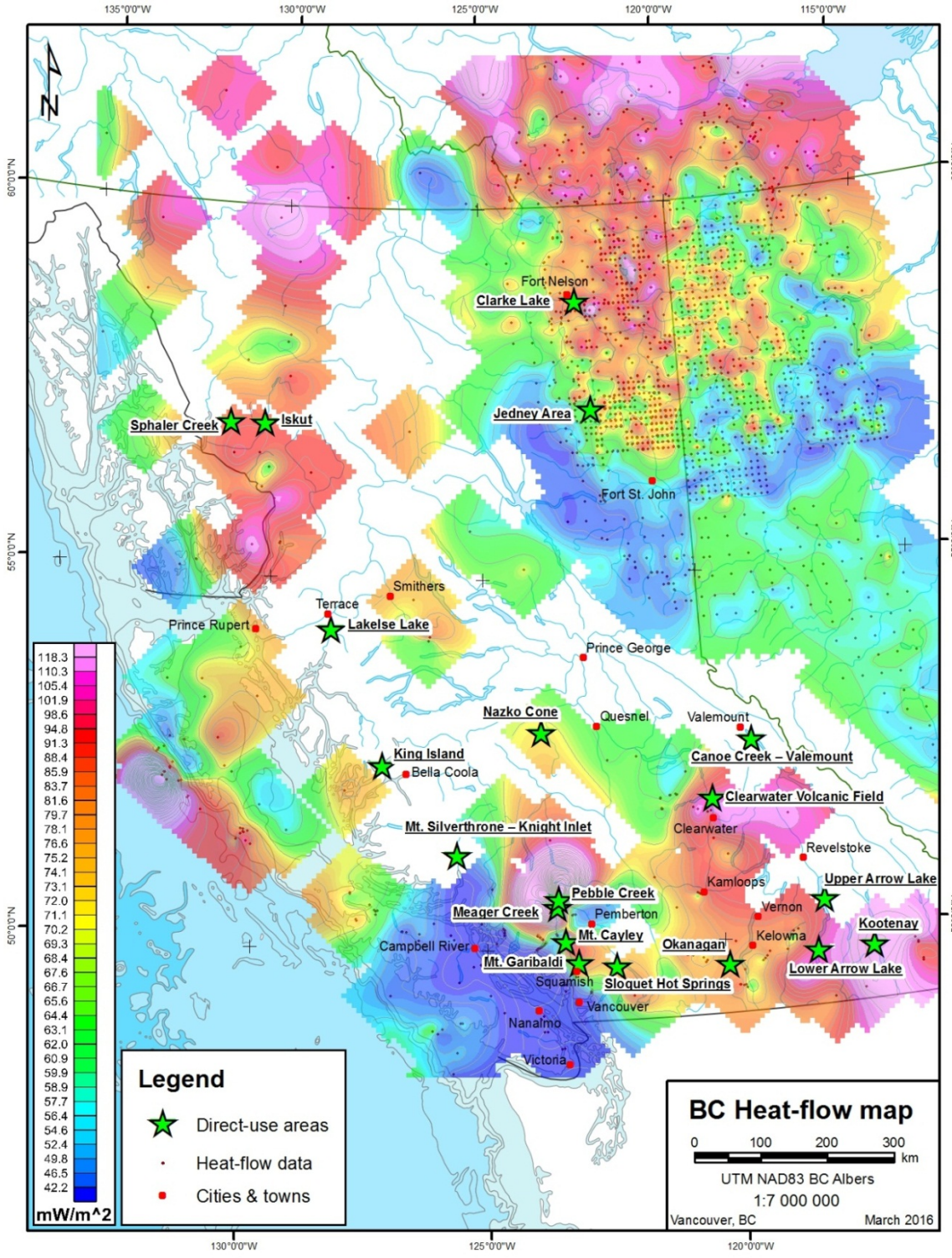

Figure 1: This updated British Columbia heat-flow map uses new data (Dr. J. Majorowicz, personal communication, 2015), as well as results from Lewis (1991) and Majorowicz and Grasby (2010a). It provides a rough guide to regions with potential Direct-use resources. Also shown are the 18 sites evaluated by Kerr Wood Leidal and GeothermEx (2015) for electrical generation, which were also evaluated for their Direct-use potential.

INTRODUCTION

Direct-use geothermal resources are a potential asset which is currently underutilized in BC. Geothermal energy uses heat produced in the earth's crust to generate electricity (indirect-use) or to heat commercial or residential spaces (Direct-use applications). As of 2015, direct utilization of geothermal energy in 82 countries totals approximately 70,000 MWt. Although BC has significant potential for geothermal resources (Figure 1), Direct-use geothermal energy is currently only used for therapeutic purposes at hot springs (Raymond et al., 2015; Woodsworth and Woodsworth, 2014)[1]. Electrical generation presents many development hurdles that lead to long project time lines (Figure 2). However, Direct-use applications have significantly lower development hurdles with significantly shorter development time frames (Hickson et al. 2016; TTGeo and GMC 2016 *Roadmap*; Figure 3), thus there are untapped resources that may be developed.

Tuya Terra Geo Corporation (TT Geo), a BC-based company, working in collaboration with Geothermal Management Company Inc. (GMC) and their respective teams, were retained by Geoscience BC in September 2015 to identify and evaluate Direct-use geothermal energy opportunities for BC communities. This project provides Geoscience BC with data that can be used to potentially lower greenhouse gas emissions and drive local economic development.

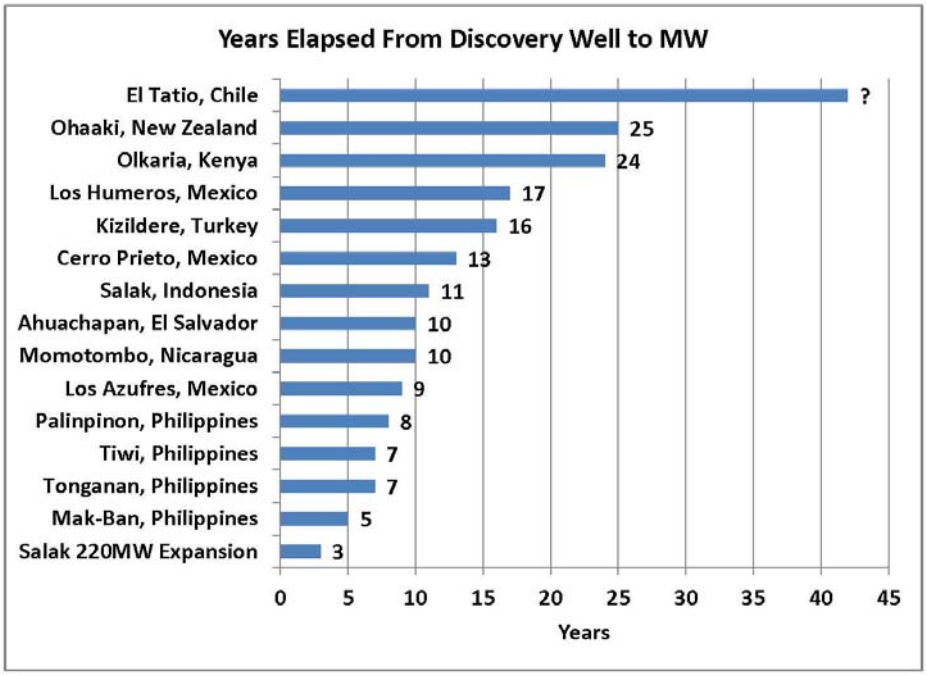

Figure 2: Some of the difficulties faced by developers when dealing with geothermal electrical-generation projects (Sussman and Tucker, 2009) are highlighted in this diagram showing years from discovery of a resource to exploitation. The barriers for direct use are much lower and projects are often completed in less than five years.

[1] Canada also utilizes geothermal energy for heating and cooling buildings (Raymond et al., 2015) through the use of heat pumps (also referred to as geoexchange, ground-sourced/earth-coupled/water-sourced heat pumps, earth energy systems). However, heat pumps harvest heat contained at the Earth's surface which is readily available in most localities and does not require elevated heat flow anomalies. For this reason, this application was not assessed as part of this report.

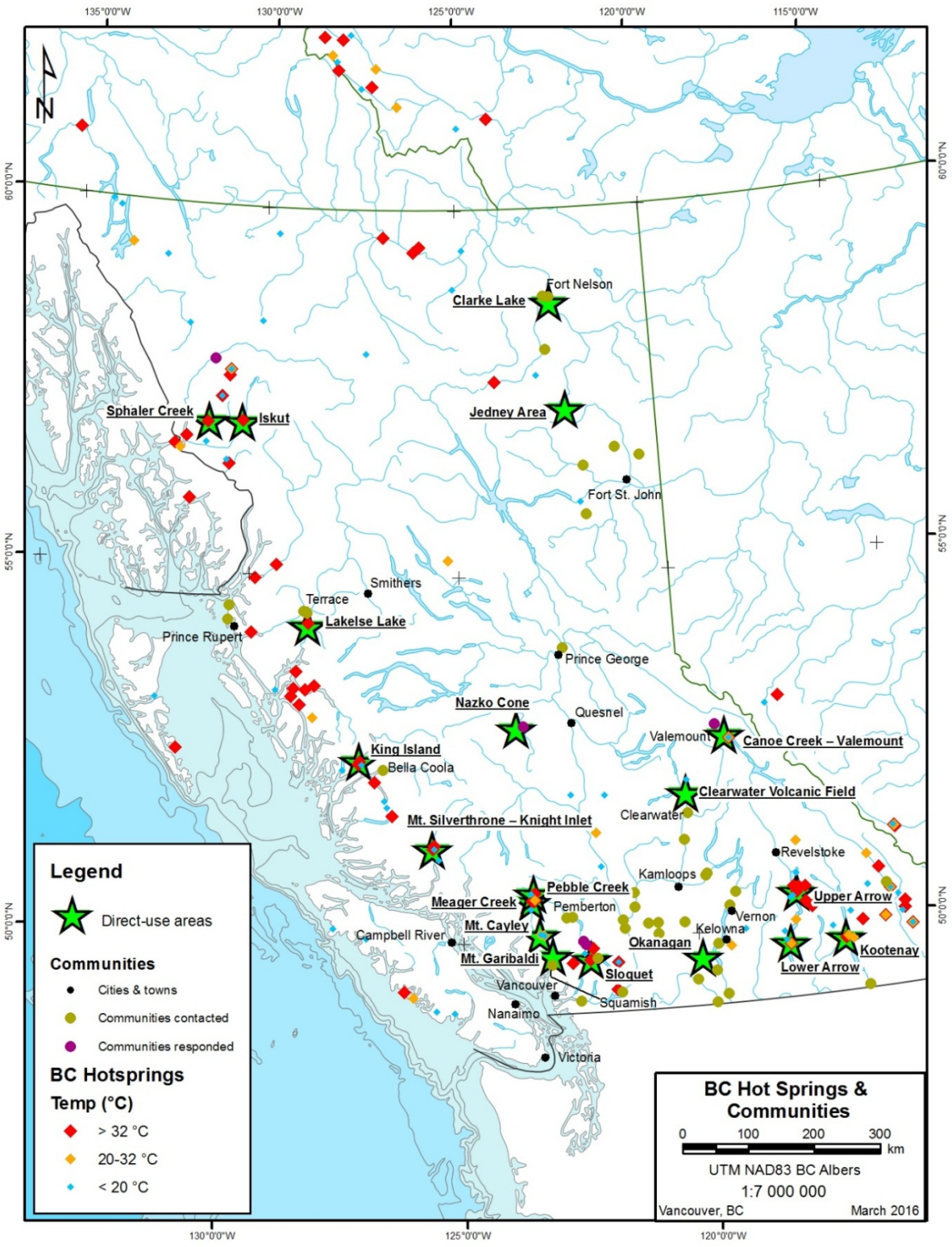

Figure 3: The communities included in this study are shown associated with known hot springs (Woodsworth and Woodsworth, 2014)

This project sought to gain a greater understanding of geothermal resources in BC and the capacity of the nearby communities to develop them. The project also provided communities with updated data about Direct-use geothermal resources. An important contribution to future development is the 'The Roadmap for Development of Geothermal Direct-use Projects in British Columbia, Canada' (the *Roadmap*; TTGeo and GMC 2016 Section B of this report). This document is a handbook for communities and developers to help them initiate their own resource development and to search for and evaluate local geothermal resources.

The current study built on the results of a previous study of the electrical generation potential for geothermal in BC by Kerr Wood Leidal Associates Ltd. (KWL) and GeothermEx (2015). This Direct-use study used information and initial prioritization from the KWL and GeothermEx study to create a list of communities in close proximity to potential Direct-use resources (Figure 1 and 3). These communities were then contacted to assess their level of knowledge of the resource and the potential for development of these resources. For this project, the 18 geothermal resource sites assessed by KWL and GeothermEx (2015) were reviewed through the GDDM (Table 1) to assess their suitability for Direct-use applications (Table 2). KWL and GeothermEx (2015) narrowed their list from 18 to 11 favourable sites for which detailed economic calculations were completed and additional development information compiled (KWL and GeothermEx, 2015). For this study we initially chose to focus our community contact on the 11 'favourable' regions assuming that since the threshold for development was lower than that required for electrical generation, the economics for a Direct-use development would be at least as favourable. However, in the end we expanded our community contacts (through First Nations connections) to all 18 sites. The 18 sites are **Canoe Creek – Valemount, Clarke Lake**, Clearwater, Iskut, **Jedney**, King Island, **Kootenay, Lakelse Lake, Lower Arrow Lake, Meager Creek/Pebble Creek, Mt. Cayley,** Mount Garibaldi, Mount Silverthrone, Nazko Cone, **Okanagan**, **Sloquet** Creek, Sphaler Creek and Upper Arrow Lake, with those in bold the subset of 11 deemed 'favourable' in the KWL and Geothermex (2015) report.

A total of 63 communities were identified as being located within close proximity to sites favourable for Direct-use geothermal. A detailed description of the study and a survey questionnaire was sent to these communities by mail or email. Follow up with the communities was completed by telephone and email. After receipt of the information package additional follow-up was carried out to address questions and provide additional information if requested.

Nazko First Nation was contacted for a pilot run of the survey questions. The Nazko First Nation communities are at close proximity to the Nazko volcanic cinder cone (Figure 1 and 3). This community was selected for the pilot run of the survey due to the relationship between some of the researchers and the community. The Research Associate, Ms. Leah Hjorth, is a member of the Band. Dr. Titi Kunkel has an ongoing working relationship with the Band and Drs. Hickson and Kunkel, and Ms. Hjorth had recently completed a geothermal project for the community. Of the 63 communities contacted, two were very knowledgeable about geothermal resources (Valemount and Nazko) and its opportunities; the rest were not. Most of the project time was spent contacting the remaining communities and providing them with publicly available data. Only four (Valemount, In-shuck-ch Nation, Tahltan Central Council, and Nazko First Nation) communities were able or willing to complete the questionnaire within the time frame of the project.

It was obvious early on in the community engagement process that more background information and a 'how-to' document was required. Most of the communities had never considered geothermal in their

TABLE 1: *Geothermal Development Decision Matrix (GDDM) with Canoe Creek-Valemount shown as an example. Numerical favourability index is represented by a number between 0 to 5. Explanations for the values can be found on page 32 under 'Geothermal Development Decision Matrix'. The completed matrix can be found in Appendix D.*

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Canoe Creek - Valemount	
	Nearest community name:	Valemount	
	Nearest large community:	Kamloops	
	Topographic map sheets (name and code) :	Canoe Mountain, 083D11	
	Geological map sheets (name and code)	83D.065	

Canoe Creek - Valemount

A.	**Resource potential**		3.14
A.1	General geological setting		5
A.2	Size/potential/type	Lake Reservoir covers part of the area to assess	3
A.3	Temperature gradient/ Heat flow data		3
A.4	Water & Gas chemistry	Cl 320 mg/L, mixing waters. Medium concentrations of bicarbonate and sulphate.	3
A.5	Mineral indicators and/or surface alteration	None reported	0
A.6	Surface thermal features (type, temperature)	50-80C reported. Lake Reservoir covers thermal features most of the year. Mud pools have been submerged since dam construction.	5
A.7	Surface spring flow rates and Resource recharge	Need a better estimate of flow rates (reported 3L/s)	3
A.8	3D permeability (heat exchange potential)	Fracture permeability	3
A.9	Recent magmatism	No	0
A.10	Structural setting / seismic / tectonics	Lots of evidence of fracturing/faulting	3
A.11	Geophysics (type and interpretation if available)	2008 Quantech MT survey suggests alteration zone at 1000 m	5
A.12	Potential Resource host rocks	Fracture permeability	5

A.13	Potential drilling issues	Fractured rock	1
A.14	Brief description of geological setting of thermal features (i.e. springs emanate from fluvial gravels; beside a river; etc.)	This is an area of high heat flow and major structures. This may make it more favourable that just the surface expression of springs might indicate.	5
B.	**Exploration Uncertainty (Risk)**		4.00
B.1	Degree of identification of resources/reserves	Surface manifestations, but resource not defined; need to define depth of waters less than 80 C; Borealis recently signed a direct heat agreement that entails using the cooled waste water (~70 degrees Celsius) coming from the power plant after power generation for purposes such as sustaining a community greenhouse for food growth and possible public hot springs facilities	4
B.2	Likelihood of covering Resource with concession	Lake coverage; Borealis holds permit	4
B.3	Expected authorization date	2016/2017	5
B.4	Specific timing of exploration (BC yr. by yr. to max 7 years)	Borealis acquired geothermal permit in 2011, ~4 years	4
B.5	Degree of previous exploration (can be good or bad)	In progress, no slim hole drilling yet	4
B.6	Surface Operational capacity (enough stable area for drilling and facilities planned?)	Reservoir covers part of the area; steep mountain valley	3
B.7	Exploration to exploitation (Difficult to easy)	In progress, favourable environment	4
C.	**Environmental Issues**		2.25
C.1	Protected areas (type and classification)	Cranberry Marsh/Starratt wildlife habitat 5 km from potential transmission connection location	3
C.2	Endangered species	Southern Mountain Cariboo habitat area ~2 km from proposed transmission route	2
C.3	Geothermal surface features	Yes, used for bathing	2
C.4	Other	Fish bearing stream crossed by potential transmission/piping route, various wildlife habitat areas (Grizzly bear, spotted owl), 5-20 km away	2
D.	**Geothermal Area - Bidding and/or type of land holding**		3.67

	(private/gov/lease/etc.)		
D.1	Bidding Area	Some permits dropped; Borealis state 2016/2017 to move forward on remaining permits. Permission to use Crown land is obtained by application under the Land Act (LA); target for Direct-use would be lower temperature < 80°C resource.	3
D.2	Electrical generation potential? Competition or collaboration possible from Companies present	KWL report	3
D.3	Other claim rights (Mining and/or Oil)	None known	5
E.	**Market**		5.00
E.1	Potential commodities for direct use applications	Village of Valemount is actively assessing Direct-use applications. Mushroom drying, forest products, greenhouses, direct heating/cooling etc.	5
E.2	Political stability and community relationship to development	Community engaged in economic evaluation	5
E.3	Time Limits? (Business agreements, Operating/generating-by deadlines?)	Current geothermal lease has been renewed and active exploration is underway (Borealis web site)	5
E.4	Renewable energy 'green value' for potential development	Valemount has active interest in green value developments.	5
F.	**Transmission Line Infrastructure**		0.50
F.1	State of the Infrastructure	No transmission to the site of the springs (>20km away); pumps and other electrical equipment would have to run off of generators/solar/wind	1
F.2	Transmission route (distance, terrain and costs)	20 km piping distance; moderate slopes	1
F.3	Wheeling power	n/a	0
F.4	Transmission providers	n/a	0
G.	**Laws governing direct-use renewable energy sources**		3.43
G.1	General Criteria of the Geothermal Law	Important aspect is the temperature criteria; under 80 C Crown Land Tenure; above	3

		geothermal law.	
G.2	General Criteria of the water resources law	Need a water use licence	3
G.3	Direct sales possible	Yes, with a licence	3
G.4	Carbon credits	BC Carbon Registry (new, in place 2016), Carbon Tax	4
G.5	Lease time and ability to renew or extend exploration licence	Geothermal lease has been renewed once; could be done under crown land tenure for lower temperature resource (<80° C)	3
G.6	Issues (and timing) related to conversion from exploration to exploitation	If done under a geothermal lease specific work program is required.	3
G.7	Time frame for exploitation licence	Crown land tenure takes weeks to months, depending on the length of tenure requested; lease up to 30 years	5
H.	**Community Issues**		3.11
H.1	Indigenous Law and Indigenous Development Areas	Different stages; two groups	1
H.2	Land claims	Asserted territory of Lheidli (stage 5); Borealis does not have a MOU with Lheidli	1
H.3	Community action	Valemount actively looking at options	5
H.4	Surface Rights	Treaty and crown land	3
H.5	Visual considerations	Lots of logging and forest service road access	5
H.6	Tourism	Springs used, many other recreational activities nearby.	4
H.7	Traditional use area: trapping, hunting, food and medicinal plants, fishing activities	Lheidli, Simpcw, Shuswap, Neskonlith first nations group (Borealis has an MOU with Simpcw and Shuswap)	3
H.8	Traditional use area: Community sacred site, gathering place or event sites	Lheidli, Simpcw, Shuswap, Neskonlith first nations group (Borealis has an MOU with Simpcw and Shuswap)	3
H.9	Traditional use area: archeology sites and other areas of significance	Lheidli, Simpcw, Shuswap, Neskonlith first nations group (Borealis has an MOU with Simpcw and Shuswap)	3
I.	**Water rights**		5.00
I.1	Availability for proposed development	2 active licenses on east side of Lake	5
I.2	Availability for drilling	yes, with a licence	5
J.	**Engineering**		2.40

J.1	Development proposal and design	no reported progress	0
J.2	Construction issues	none reported	3
J.3	Transportation issues	none reported	3
J.4	Architectural Issues (blend/hide into environment? Local styles? Etc.)	none reported	3
J.5	Special construction issues (heat exchanger & full injection)	none reported	3
K.	**Non electrical infrastructure (roads and habitation)**		3.80
K.1	Nearest large community > 50,000	Kamloops is a major center for trades and material	4
K.2	nearest community and size	Valemount (1000 people)	2
K.3	Nearest road and condition	unpaved road	3
K.4	Current access conditions (restrictions)	unpaved roads; close enough to Valemount for staff	5
K.5	Terrain and distance factor for road building	no requirements for new roads	5
L.	**Development Finance**		0.00
L.1	Development value (greenhouses; tourism; heating; etc.)		0
L.2	Market price for similar commodities not using direct-use heat		0
L.3	Green power premium for commodity?		0
L.4	Commodity price		0
L.5	Marketing implications		0
L.6	Estimated size of resource		0
L.7	Are there any green use incentives?		0
L.8	Grants		0
L.9	Tax holidays		0
L.10	Tax relief		0
L.11	Loan guarantees		0
L.12	Royalties/Fees		0
L.13	General idea of royalties		0
L.14	Private land owner or government land		0
L.15	Tax rate in the country		0
L.16	Transmission Tariffs		0

M.	**Maps**		5.00
M.1	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)		5
M.2	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks) (1:500,000?)		5
M.3	Regional geological map (1:250 or 500,000?)		5
M.4	Detailed geological map of the immediate area of the concessions (1:50,000 or 100,000)		5
N.	**Other issues and considerations**		2.00
N.1	Spatial concentration of potential customers	Valemount is a small community	2
N.2	Distance to market for prospective commodities	Kamloops and Edmonton closest markets	3
N.3	Costs to potential customers to receive Direct-use benefits	no subsidies	1

OVERALL COMMENTS/ASSESSMENT:	Valemount is actively interested in pursuing Direct-use applications. They have had workshop to investigate the options. They have looked at mushroom growing; greenhouses, and heating.

planning and economic development process (although all who have an Official Community Plan (OCP) are required to state their GHGE reduction targets). The learning curve proved too steep and within a short time frame to fully engage most communities in considering Direct-use geothermal as a development option for their communities. This knowledge gap will be filled by the *Roadmap* but most communities will still need additional assistance to help them in their development decisions.

TTGeo and GMC have carried out this data gathering and information analysis using a community based participatory approach with a strong First Nations emphasis. Many of the communities in BC with Direct-use potential are First Nations or have significant First Nations representation.

The work did not include geoexchange (sometimes referred to as geothermal heat-pump or 'ground-sourced' geothermal) potential though most communities in BC could take advantage of this shallow sub-surface technique used to store and release heat. However, in the community-based methodological approach, it was discussed as part of the information exchange on geothermal, but was not part of the questionnaire.

Community-based participatory methods have, in the past, been successfully carried out with Aboriginal communities in BC. This approach has the added advantage of building community research capacity and resource development awareness. The information package created was focused on building this capacity (Appendix A). In addition, this approach enhances the relationship building and paves the way for future community engagement and development of identified resources. As noted above, during this process, two important missing components were identified: lack of knowledge of the range of Direct-use applications for which a geothermal resource could be utilized and the necessary steps required to develop a Direct-use geothermal project. It was during this process that the *Roadmap* was determined to be a critical missing element and will become the main tool for participatory learning during future engagement with communities.

In addition to the identification of communities and community geothermal champions in locations with potential for Direct-use development (Appendix B), this project compiled a background information package on Direct-use applications (Appendix A); updated the heat flow map of BC (Figure 1); expanded the community information (Appendix C) for the decision matrix (Table 1, Table 2 and Appendix D); compiled community survey results (Appendix E); expanded and updated the geochemical inventory of hot springs (Table 3 and Appendix F); and created a *Roadmap* (separate document Section B) for communities to follow. These tools will provide the necessary background and guidance for communities as to how to move forward on Direct-use projects, addressing many technical and non-technical aspects.

METHODOLOGY AND RESULTS

The Project was divided into three phases, outlined below.

Phase 1: Identify regions and communities in BC with potential for Direct-use geothermal energy development.

1. The compilation of existing, publicly available BC geoscience datasets useful for the evaluation of Direct-use geothermal energy was completed. These data and associated maps will be made available publicly by Geoscience BC on their website.
2. In parallel with the data compilation, a Geothermal Development Decision Matrix (GDDM) was developed to evaluate and differentiate the 18 areas identified by Geoscience BC and analyzed in the KWL and GeothermEx (2015) electrical generation study in conjunction with the associated communities. No additional areas were added even though hot springs exist which are significantly hotter (see Figure 3) than those within the 18 sites. This was because the communities in close proximity to the 18 focus regions encompassed the outlying hot spring areas and most are remote hot springs deemed to havelimited commercial developability potential for Direct-use applications (for example those around Iskut, Figure 3).

3. In the KWL and GeothermEx report, seven sites (out of the 18) were rejected from detailed analysis due to major barriers to development (see their Table 4-2, p. 4-2). Our study is consistent with their findings for three of the areas. These three areas, Iskut, Mount Silverthrone, and Sphaler Creek, lack transmission and any sort of infrastructure. They are in remote locations where only occasional tourist visits are possible. If mining were to be developed in close proximity to any of these areas, Direct-use should be re-evaluated. However, short term development of Direct-use applications is not considered a realistic option unless there are specific circumstances that make such development economically feasible.

   Other areas, such as Clearwater volcanic field and Iskut hot springs are part of wilderness provincial parks and as elucidated in the GDDM results are less favourable for development. Despite this barrier, they were included in the community contact lists because of overlapping First Nations land claims with other potential resource areas. Nazko, which did not make the KWL and GeothermEx (2015) short list for electrical generation, was included in our study for detailed follow-up because the Nazko community has had a long history of interest in geothermal energy and there is a higher likelihood of a low temperature resource suitable for Direct-use. In all, 63 communities were identified and detailed community engagement was carried out with these communities. The list of the 63 communities contacted can be found in Appendix B.

4. The data compilation provided a basis for the identification of a first list of communities and regions with Direct-use potential. As noted above, a total of 63 communities were identified to be in close proximity (or have asserted rights to the land) to the 18 sites provided by Geoscience BC (Figure 1 and 3). The survey questionnaire was developed for communities to identify their needs, development choices and economic development goals, with the objective of paving the way for future community engagement and development of identified Direct-use resources. The content can be found in Appendix A.

Phase 2: Build community-research capacity and increase communities' awareness and knowledge of geothermal resources in their region:

5. A review of the community and technical information gathered for the 18 sites was completed. An information package and the survey questionnaire (also made available online) were sent to the communities identified in Phase 1. It became immediately apparent that the communities required more background material in order to respond to the survey questionnaire in a meaningful way.

   Once the information package was received by the community, it was necessary to correspond with them. Follow-up telephone conversations with community members receiving the information package were completed. These led to two meaningful interviews and several requests for additional information. In addition there were a number of insightful conversations with community members. These revealed that even with the information package and repeated follow-ups only a few communities had enough knowledge to complete the questionnaire. In most cases, Direct-use had not been considered in the community planning so significant work was required by the community to consider geothermal resource development

options. The communities needed the *Roadmap* to take the next steps. Disappointingly, only four communities were able to complete the questionnaire in a meaningful way. Their responses are found in Appendix E.

6. The GDDM was useful as a high level tool to evaluate the overall suitability of a region to Direct-use development (Table 1). The factors considered for each site are listed in Table 1 using Canoe Creek-Valemount as an example. Weighting factors for the GDDM were finalized and the result was a sliding scale that highlighted those sites more favourable for Direct-use development (Table 2). Like the ranking for electrical generation, remoteness and lack of electrical transmission flagged three areas as less favourable (Iskut, Mount Silverthrone, and Sphaler Creek) and gave them a 'low' ranking. Clearwater was also ranked 'low' due to the lack of surface manifestations outside the area protected within Wells Gray Provincial Park.

Phase 3: Summarize and analyze the community engagement process, the GDDM results, and complete 'The Roadmap for Development of Geothermal Direct-use Projects in British Columbia, Canada' (the *Roadmap*).

7. The results of the community-engagement (Appendix C and E) and GDDM ranking (Table 2, Appendix D) were summarized and analyzed. As noted above, a major finding was that communities could only be evaluated in terms of their ability to undertake Direct-use projects and proximity to a known resource. Most of the communities simply did not have enough knowledge to make decisions and had never considered Direct-use applications within their community planning framework, despite having an OCP with GHGE reduction targets.
8. The *Roadmap* developed and written for this project was designed to address this community knowledge gap. The *Roadmap* includes information to support key considerations in the assessment and development of potential Direct-use geothermal resources.

Table 2: *Geothermal Development Decision Matrix – summary results shown for the 18 sites considered in the project.*

	Development Factor (Name of region/area) MW reported from KWL & GeothermEx 2015	Suggested favourability for Direct-use	Transmission Line	Finance & Regulations	Environmental	Community	Resource	Roading Access & Constructability	Weighted Total		
			F	D+E+G+L	C	H	A+B+M	I+J+K+N			
			1	2	3	5	5	3	19	Ranking	Comments
A	Canoe Creek - Valemount (15 MW)	high	0.5	3.0	2.3	3.1	4.0	3.3	59.0	3.10	Receptive community; financial and technical support needed
B	Clarke Lake (34 MW)	high	1.5	2.4	3.8	3.8	4.1	3.3	66.8	3.52	Receptive community; financial and technical support needed
C	Clearwater (10 MW)	low	0.5	1.1	1.5	2.7	2.3	2.7	40.1	2.11	Temp. grad. work in the N. Thompson valley to confirm high heat flow; results might change ranking significantly.
D	Iskut (10 MW)	low	0.5	2.7	0.8	2.3	2.9	2.7	42.3	2.23	Remote location with limited population and development: new geochem Taweh (Sezill) (thanks to Polaris Infrastructure)
E	Jedney area (15 MW)	high	0.5	2.4	3.5	3.1	3.9	2.7	58.6	3.09	Remote location with limited population and development potential
F	King Island (20 MW)	moderate	0.5	2.2	2.0	2.7	3.4	2.3	48.2	2.54	Remote site; established lodge for sale (as of March 2016)
G	Kootenay (20 MW)	moderate	2.5	2.4	2.0	2.8	3.8	3.5	56.8	2.99	Ainsworth may be open to Direct-use applications; new geochem Wildhorse (thanks to Polaris

											Infrastructure)
H	Lakelse Lake (20 MW)	high	1.0	2.0	2.5	2.6	4.1	4.5	59.5	3.13	Electrical generation project underway; potential for Direct-use
I	Lower Arrow Lake (20 MW)	moderate	1.8	2.2	3.3	2.4	3.5	3.1	54.9	2.89	Remote location with limited population and development
J	Mount Meager (100 - 200 MW)	high	3.0	2.8	2.0	2.7	4.3	3.0	58.4	3.08	Remote site; new hydro project and transmission; upgraded access to Pebble Creek HS
K	Mt. Cayley (50 MW)	moderate	0.5	2.4	3.0	2.8	3.8	2.7	55.1	2.90	Remote site; good access; new chemistry for Turbid Creek HS (thanks to Polaris infrastructure)
L	Mt. Garibaldi (50 MW)	moderate	1.5	2.9	3.0	2.8	2.7	3.6	54.5	2.87	Slightly lower score than Cayley is due to lack of a defined resource.
M	Mt. Silverthrone (50 MW)	low	0.0	2.9	2.0	2.6	3.0	2.0	45.4	2.39	Remote location with no population
N	Nazko Cone (10 MW)	moderate	0.0	2.2	2.5	2.7	3.8	3.2	53.8	2.83	Remote location with limited population and development
O	Okanagan (20 MW)	high	0.5	2.4	2.8	2.9	3.6	3.8	57.3	3.01	Potentially receptive community, recreational area.
P	Sloquet Creek (10 MW)	high	3.8	2.4	3.0	2.9	3.6	3.1	59.5	3.13	Potentially receptive community, recreational area.
Q	Sphaler Creek (10 MW)	low	0.0	2.2	2.8	2.3	2.9	2.0	44.9	2.36	Remote location with limited population and development
R	Upper Arrow (20 MW)	moderate	0.5	2.2	2.0	3.0	3.7	3.2	53.7	2.83	new chemistry St. Leon & Taylor (thanks to Polaris Infrastructure)

*Weighting factors are based on an analysis of the developability of an area using available data. The weighting factors used were biased towards a likely resource with temperatures between 40–80° C (or higher) and a receptive community. Favourability (low, moderate, high) were assigned based on the weighted ranking. High, 3.00 and above, moderate between 3.00 and 2.50 and those below 2.50 were assigned a low.

Research Methods

Phase 1: As a first step, a compilation of existing BC geoscience and spatial datasets useful for the evaluation of Direct-use geothermal energy was completed. The Project used Fairbanks and Faulkner (1992), Hickson et al. (2016), Kimball (2010), Kunkel (2014), Western Renewable Energy Zones (2009), Williams et al. (2008), and Woodsworth and Woodsworth (2014) in addition to the detailed KWL and GeothermEx (2015) study. As part of this compilation, the heat flow map for BC was updated (Figure 1; personal communication with Dr. Majorowicz, 2015) and the geochemistry of hot springs database was updated with information provided by Dr. Glenn Woodsworth and Mr. Ron Yehia in addition to new data provided by Polaris Infrastructure Corp

From these and other sources, a list of sites and communities with Direct-use potential was compiled (Appendix B). These communities were contacted, interviewed and asked to fill in the survey questionnaire (Appendix A). It was soon determined that very few communities had any specific knowledge of the potential for Direct-use applications in their region. This resulted in further information being provided to the communities who requested it.

In parallel with the compilation, the GDDM (Table 1) was refined by the TT Geo and GMC team. This GDDM framework was originally created by Dr. Hickson and her exploration team at Magma Energy Corp. (now Alterra Power Corp.) for use in their global exploration program. It was intended as a way of differentiating between multiple projects in various jurisdictions. Geoscience BC's Geothermal Technical Advisory Committee (TAC) modified the decision matrix for use in defining the scope of work for its 2014 Request for Proposal on electrical generation.

For the purpose of this study, the matrix was customized to include more community elements (such as those covered in the 'Traditional use area' in Section H (Table 1; Appendix C) and additional factors related to Direct-use (Section N; Table 1; Appendix D). Less emphasis (through the weighting factors used in the GDDM) was placed on factors more directly linked to electrical generation development such as transmission. Members of the team reviewed the elements of the matrix and provided feedback as to its best application and weighting. It was determined that a simple 1 to 5 value, applied as: less favourable (1); neutral (3); and favourable (5), was sufficient to evaluate the communities.

The GDDM was populated with both primary (from the community) and secondary data collected about the communities from other sources such as their community development plans. The KWL and GeothermEx (2015) results were compared with earlier studies by Western Renewable Energy Zones (2009), Kimball (2010), Kunkel (2014), Fairbanks and Faulkner (1992), and Woodsworth and Woodsworth (2014).

In this phase the project also compiled known Direct-use projects (Table 3). These were all recreational facilities. As noted previously ground based geothermal (geoexchange) was not considered.

Phase 2: In this phase, processes were designed to build community-research capacity and to increase communities' awareness and knowledge of geothermal resources in their region. An interview package consisting of the project information, a consent form, and the survey questionnaire was developed. The project proposal was to focus on 25 communities; however, there were at least 63 communities surrounding these resource locations. The interview package was circulated among the project team for feedback and to Geoscience BC for input on ethical guidelines. Amendments were made to the interview package based on the feedback received. A test interview was conducted with the Nazko First Nation. This was to try out the questions and to make further amendments. The final interview package

was mailed out to 56 of the communities. Including the Nazko community (this package was hand delivered), a total of 57 packages were sent to communities (see Appendix B) and in total 63 communities were contacted. It was assumed that the communities would have been familiar with the KWL and GeothermEx (2015) report; however, this was not the case. It was also assumed that communities were aware of the location or manifestations of geothermal resources within their area; this also proved not to be true. Several communities were provided with the KWL and GeothermEx (2015) report results and other links to background information.

TABLE 3: *Inventory of hot springs in British Columbia and Alberta (from Woodsworth and Woodsworth, 2014) and their status in terms of Direct-use application.*

T (°C) [Note 2]	Spring name [Note 3]	Province	Status [Note 4]
87	Dewar Creek	BC	Undeveloped; Purcell Wilderness Conservancy
85	Lakelse (Mount Layton)	BC	Commercial facility (closed); and undeveloped
83	Hoodoo Creek	BC	Undeveloped
75	Iskut River	BC	Undeveloped; Iskut River Provincial Park
69	Tallheo North	BC	Undeveloped
67	Sloquet	BC	Undeveloped
67	Kinbasket Lake (Canoe Reach, Canoe River)	BC	Undeveloped, within BC Hydro reservoir
63	Harrison	BC	Commercial facility
62	Sheemahant	BC	Undeveloped
61	Halfway River	BC	Undeveloped to semi-developed
60 [Note 5]	Hotspring Island (Gandll K'in Gwaay.yaay)	BC	Undeveloped; Gwaii Haanas National Park Reserve
60	Choquette (Stikine River, Fowler)	BC	Undeveloped; Choquette Provincial Park
59	Meager Creek	BC	Semi-developed
59	Pebble Creek (Keyhole)	BC	Semi-developed
58	Nakusp	BC	Commercial facility
58	Grayling River	BC	Undeveloped; Grayling River Ecological Reserve
57	Pitt River	BC	Semi-developed
57	Tallheo South	BC	Undeveloped
56	Klekane Inlet	BC	Semi-developed; Klekane Conservancy
55	Miette	AB	Commercial facility; Jasper National Park
55	Aiyansh (Hlgu Isgwit, Zolzap)	BC	Undeveloped
55	Eucott Bay	BC	Semi-developed
54	Halcyon	BC	Commercial facility
54	Upper Halfway River	BC	Undeveloped
52	Liard (Alpha)	BC	Semi-developed; Liard Hot Springs

T (°C) [Note 2]	Spring name [Note 3]	Province	Status [Note 4]
			Provincial Park
51	Tsek (Skookumchuck, St. Agnes' Well)	BC	Semi-developed
51	August Jacob's (Frank Creek)	BC	Undeveloped; Maquinna Marine Provincial park
51	Hot Springs Cove (Sharp Point, Ramsay)	BC	Undeveloped; Maquinna Marine Provincial park
50	St. Leon	BC	Semi-developed
49	Octopus Creek	BC	Undeveloped
49	Fairmont	BC	Commercial facility
48	Ainsworth	BC	Commercial facility
48	Sphaler Creek	BC	Undeveloped
48	Portage Brûlé	BC	Undeveloped; Portage Brule Rapids Ecological Reserve
47	Clear Creek (Ruth Larsen)	BC	Semi-developed
47	Radium	BC	Commercial facility; Kootenay National Park
47	Upper hot spring at Banff	AB	Commercial facility; Banff National Park
47	Weewanie	BC	Semi-developed; Weewanie Hot Springs Provincial Park
46	Frizzell	BC	Semi-developed
46	Sezill (Taweh Creek)	BC	Undeveloped; Mt Edziza Provincial Park
45	Placid	BC	Undeveloped
45	Burton Creek	BC	Undeveloped
45	Canyon Lake	BC	Undeveloped
45	Shearwater (Europa Bay)	BC	Semi-developed
44	Nascall	BC	Commercial facility (closed)
44	Goat Harbour	BC	Undeveloped
44	Bishop Bay	BC	Semi-developed; Bishop Bay - Monkey Beach Conservancy
43	Lussier (Whiteswan)	BC	Semi-developed
43	Mess Creek	BC	Undeveloped; Mt Edziza Provincial Park
41	Liard, Beta pool	BC	Semi-developed; Liard Hot Springs Provincial Park
40	No Good	BC	Undeveloped
40	Riondel	BC	Undeveloped; inaccessible in mine shaft
39	Kidney (Banff)	AB	Undeveloped; Banff National Park
38	Brim River	BC	Undeveloped; Brim River Protected Area
37	Buhl Creek	BC	Undeveloped
37	Ram Creek	BC	Undeveloped; Ram Creek Ecological Reserve

T (°C) [Note 2]	Spring name [Note 3]	Province	Status [Note 4]
37	Middle at Banff	AB	Undeveloped; Banff National Park
37	Prophet River	BC	Undeveloped; Prophet River Provincial Park
36	Elwyn Creek	BC	Undeveloped; Mt Edziza Provincial Park
35	Little Wilson Lake	BC	Undeveloped
35	Basin at Banff	AB	Commercial facility; Banff National Park
35	Deer River	BC	Undeveloped
34	Mist Mountain	AB	Undeveloped
34	Len King (King Creek)	BC	Undeveloped
33	Wild Horse	BC	Undeveloped
32	Angel (KLO)	BC	Undeveloped
32	Crawford Creek	BC	Undeveloped
31	Cave spring at Banff	AB	Undeveloped; Banff National Park
29	Turbid Creek	BC	Undeveloped
29	Atlin	BC	Undeveloped
28	Canoe Creek	BC	Undeveloped
28	Tchentlo Lake	BC	Undeveloped
27	Shovelnose	BC	Undeveloped
27	Canyon (Albert Canyon)	BC	Commercial facility
26	Fording Mountain (Sulphur)	BC	Undeveloped
25	Mate Island	BC	Undeveloped
25	Ahousat (Flores Island)	BC	Semi-developed; Gibson marine Provincial Park
25	Taylor	BC	Undeveloped
23	Khutze Inlet	BC	Undeveloped
21	Vermilion Lakes	AB	Undeveloped; Banff National Park
19	Red Rock	BC	Undeveloped
19	Job Creek	BC	Undeveloped
14	Morin South	BC	Undeveloped
13	Mess Lake	BC	Undeveloped; Mt Edziza Provincial Park
13	Jones Lake	BC	Undeveloped
12	Williams Lake	BC	Undeveloped
11	Kaslo Creek	BC	Undeveloped
11	Ray's Mineral Spring	BC	Undeveloped
14	Clearwater	BC	Undeveloped
9	Sulphur Cold	AB	Undeveloped
8	Elaho River	BC	Undeveloped

T (°C) [Note 2]	Spring name [Note 3]	Province	Status [Note 4]
8	Riske Creek	BC	Undeveloped
8	Brigham	BC	Undeveloped
8	Tlell	BC	Undeveloped
Springs without precise locations or good temperature estimates [Note 6]			
hot	Asseek River	BC	Undeveloped
warm	Cogburn Creek	BC	Undeveloped
warm?	Daly's (Glacier lake)	BC	Undeveloped
hot	Frog River	BC	Undeveloped
flooded	Link Lake	BC	Undeveloped
warm	Nakina	BC	Undeveloped
hot?	Sheslay River	BC	Undeveloped
hot	Toad River	BC	Undeveloped; Toad River Provincial Park
Rumoured springs that might not exist [Note 7]			
	Bella Coola	BC	
	Blue River	BC	
	Brooks Peninsula	BC	
	Bryneldsen Bay (Ram Bluff)	BC	
	Fair Harbour	BC	
	Fosthall	BC	
	Franklin River	BC	
	Hartley Bay	BC	
	Hoodoo Mountain	BC	
	Kennedy River	BC	
	Lepine Creek	BC	
	Link Lake	BC	
	Mt Maldur	BC	
	Phillips Arm	BC	
	Pipestem Inlet	BC	
	Snippaker Creek (Julian Lake)	BC	
	Snowshoe Rabbit	BC	
	Tatshenshini River	BC	
	Thorsen Creek	BC	
	Trutch	BC	
	Twenty-Mile Bay	BC	

T (°C) [Note 2]	Spring name [Note 3]	Province	Status [Note 4]
	Washwash River	BC	

Note 1.	Modified from Woodsworth and Woodsworth (2014). The list of springs below about 13°C is incomplete. Only those springs with good publicly available chemistry or which have been mentioned in previous geothermal reports are included.
Note 2.	Temperature (°C) is the highest reliably measured temperature at the spring. This may differ from that given in Appendix F, which gives temperatures measured when samples for chemical analysis were collected. Temperatures have been rounded up to the next highest degree.
Note 3.	Alternate and old names are in parentheses.
Note 4.	Commercial facilities have permanent, concrete pools and are regulated by the province. Semi-developed springs may have small, concrete or wood soaking pools but have no chlorination or other treatment. Undeveloped springs range from pristine wilderness to those with rough soaking pools made of mud or river rocks.
Note 5.	60°C is the maximum post-2012 earthquake temperature. Pre-2012 temperatures reached 77°C.
Note 6.	These springs are known to exist, but no good temperature measurements are available. In most cases, precise locations are not available, either.
Note 7.	Many of these springs are mentioned on Fairbank and Faulkner (1992) without proper location data and no temperature information. Others appear in old guidebooks or other sources. Some may be old or obsolete names for well-known springs; others may have dried up; others are probably rumours.

The 63 communities contacted included many First Nations' Tribal Councils; contacted were Adams Lake Indian Band, Akisn'uk First Nation, Bella Coola, Blueberry First Nation, , Clearwater Regional District, Coldwater First Nation, Cook's Ferry Indian Band, Dene Tha' First Nation, Doig River First Nation, Douglas First Nation, Town of Fort Nelson, Fort Nelson First Nation, Halfway River First Nation, Halfway River First Nation, In-Shuck-ch First Nation, Kitselas First Nation (and Kitselas Development Corp.), Kitsumkalum First Nation, Ktunaxa Nation Council, Kwantlen First Nation, Lax Kw'alaams Band Council, Lheidli Indian Band, Lillooet Tribal Council, Lower Kootenay Indian Band, Lower Nicola Indian Band, Lower Similkameen First Nation, Lytton First Nation, Metlakatla First Nation, Mount Currie Lil'wat Indian Band, NanWakolas First Nation, Nazko First Nation, Neskonlith Indian Band, Nicola Tribal Association, Nlaka'pamux Nation, Nooaitch First Nation, Okanagan Indian Band, Oregon Jack Creek First Nation, Osoyoos First Nation, Village of Pemberton, Penticton Indian Band, Prophet River First Nation, Samahquam First Nation, Seabird First Nation, Secwepemc First Nation, Shuswap Indian Band, Simpcw First Nation, Sinixt First Nation, Siska First Nation, Skat'in First Nation, Splats'in First Nation, District of Squamish, Squamish First Nation, St. Mary's Indian Band, St'at'imc Chiefs Council, , Stó:lō First Nation, Sts'ailes First Nation, Tahltan First Nation, City of Terrace, Tobacco Plains First Nation, Upper Nicola Indian Band, Upper Similkameen Indian Band, Village of Valemount, Westbank First Nation, and West Moberley First Nation. Most of the communities received the detailed interview package (Appendix A)

which was then followed up with telephone calls between October 2015 and February 2016 (Appendix B).

Telephone calls were made to the communities and Tribal Councils to provide the project outline and information, to obtain informed consent, and to conduct semi-structured interviews using the questionnaire. The questionnaire was designed to gather data about community contact information, Aboriginal traditional land use in and around the resource areas, current and planned economic activities, development interests, and consultation protocols and information for prospective developers. An online survey was developed for people who did not have the time to answer interview questions by telephone. In such cases, the telephone calls were used to provide detailed information about the project; about geothermal resources; and to obtain informed consent. During these calls, a 'community champion' (a potential geothermal protagonist) was identified along with a valid email address. The link to the online survey was then sent to the community champion. The four responses received to the questionnaire can be found in Appendix E.

Secondary data was needed to provide additional information about the communities contacted. This information included the community profile; economic interests; relevant information about lands claim, title, and Aboriginal rights; traditional activities and land use information; web address, current contact information; and affiliated communities. These data were gathered and compiled by Ms. Yuliana Proenza of APEX Geoscience and included in the updated GDDM Section H (Appendix C and D).

The information collected for the primary data was obtained directly from communities (Appendix E) and the secondary data available online on websites and various community documents were assessed in order to determine the weighting factors for the GDDM. Unfortunately the primary data collection was very sparse and limited.

Although a lot of effort was expended to obtain valuable and quantifiable answers, the resulting community response was poor. In summary, four communities provided feed-back and three communities (Nazko, Terrace and Valemount) have expressed interest in hosting pilot projects for Direct-use. Valemount recently hosted a Geothermal workshop (February 12 and 13, 2016 http://valemount.ca/geo-workshop).

Phase 3: The importance of the *Roadmap* was identified early on in the process. The *Roadmap* (section B of this report) includes guidelines for the following steps: 1) conduct of ground-surface based activities designed to characterize the resource (geology and geochemistry, possibly some geophysics depending on location and circumstances), 2) acquisition of land control, 3) acquisition of all Federally, Provincially, and locally required permits, 4) the drilling of shallow thermal gradient holes, 5) drilling of either slim-hole(s) or production/injection well(s) (depending on the amount of money available), 6) testing of wells, and 7) design and construction of facilities for beneficial, commercial use and disposal of the produced thermal fluids. The technical aspects of Direct-use applications that are covered by the *Roadmap* and would be well-suited for BC include: therapeutic uses and bathing at hot springs, aquaculture (fish farms), greenhouse heating, district heating, pavement and sidewalk snow-melting, vegetable/fruit/fish drying and lumber drying.

As the *Roadmap* document was completed at the end of January,a review by the Geoscience BC's Geothermal Technical Advisory Committee (TAC) was requested and comments were incorporated into the final document (Report 2016-07 Section B; TTGeo and GMC 2016).

Geothermal Development Decision Matrix

The GDDM was completed for all 18 sites. Unlike the weighting exercise carried out for electrical generation by KWL and GeothermEx (2015), our analysis heavily weighted the potential resource and the community's interest and willingness to consider Direct-use applications as part of their community plan. Some communities have already identified Direct-use as a way to reduce green-house gas emissions (GHGE) in their communities (for example, Valemount and Fort Nelson).

The GDDM factors were evaluated under 14 sections (Table 1; Appendix D). For analysis, these factors were consolidated into six groupings; Transmission, Finance and Regulations; Environment; Community; Resource; Roading Access & Constructability (Table 2; Appendix D). The maximum attainable score was 70 if a value of 5 (most favourable) was given by the expert input for each of the 14 factors. The valuation was carried out jointly by Ms. Yuliana Proenza and Dr. Catherine Hickson. The grouping of the factors reduced the maximum obtainable score to 30 (a favourability value up to 5 for each of the six groupings) and this number was then manipulated by applying a weighing factor to each grouping: Transmission (1), Finance and Regulations (2); Environmental (3); Community (5); Resource (5); Roading Access & Constructability (3). This resulted in a weighted total out of a potential maximum of 95 (Table 2). Division by the weighting factors was then used to achieve a number between 1 and 5 called 'Ranking'. The reasoning behind these weightings is given below.

A fairly clear favourability ranking (low, moderate, and high) was achieved based on the weighted ranking. 'High' was assigned to those ranked 3.00 and above, 'moderate' between 3.00 and 2.50 and those below 2.50 were assigned a 'low'. Through this process it is now easy to identify where additional information and community input is required to change the ranking (Table 2; Appendix D). As soon as additional information in gathered the matrix can be revisited and the site re-evaluated.

The following assumptions were made:

Transmission was weighted the lowest (1) because local generation can be used for Direct-use applications (heat pumps, small scale hydro, etc.). However, it was deemed more favourable if electricity was available on-site. Values were assigned based on the following. As a general guideline, if the site is less than 7 km from transmission over favourable terrain, it was given a value of 5; 7-15 km was given a value of 3 and >15 km was assigned a value of 1.

Finance and Regulations was weighted a (2). This grouping included Factors/Sections **D** Geothermal Area - Bidding and/or Type of Land Holding (private/government/lease/etc.); **E** Market; **G** Laws Governing Direct-use Renewable Energy Sources and **L** Development Finance. Under **D** Geothermal Area Bidding and/or Type of Land Holding, geothermal permits already in place (Geothermal Resources Act), as well as mineral/coal/oil and gas tenures were not considered to be a hindrance to Direct-use applications as Direct-use typically would only require Land Act tenure leases. Electrical generation potential of the 11 favourable sites identified by KWL and GeothermEx (2015) was considered more favorable and they were given a value of (3); the remaining 7 sites were assigned a (2) or (1).

Under Factor **G** most sites received a 3.43 as Laws were considered province-wide and were not considered prohibitive for Direct-use development. The only exceptions to this were Clearwater and Iskut, due to the likely resource areas being protected within a Provincial Park. Additional exploration in these areas may show that there is resource outside the protected areas and thus change the weighting.

It is important to reiterate that Direct-use has a lower development threshold than electrical generation, particularly if a geothermal lease is not needed. Under Factor **E** Market, local population, remoteness,

ease of getting product to market, and examples of Direct-use applications that suggested the community would be favorable to development garnered the highest values. Also considered was accessibility to local commodities (forest products, agricultural products, etc.). This section is the dominant factor that impacts the resulting score as all sites were assigned (0) for Factor **L** Finance. Since no specific Direct-use projects are underway there was no information that could be used to evaluate the financial aspects of a project.

Environmental (Section **C**) was evaluated based on land status and weighted a (3). Land dispositions that complicate development such as Provincial Parks, Nature Conservancies, at risk/endangered species habitat areas, local geothermal surface features, and fish bearing streams were discounted. In the case of many of the protected (protecting volcanic areas and hot springs specifically) parks (for example, Garibaldi, Iskut River Hot Springs and Wells Gray Provincial Parks), the manifestations are most likely in the park and not easily accessible for development. These areas were less favourably ranked as significant environmental hurdles can slow down or prevent the development process. The presence of an existing hot spring resort was considered less favourable for new development due to the potential for conflicting water and land use. On the positive side, an existing facility also opens doors to other uses able to piggy-back on established infrastructure but these must be evaluated on a case-by-case basis. Sites with no tourism, no development, and no protected areas were ranked most favourably under this section.

Community (Section **H**) includes comments on negotiation for Land Claims and was weighted a (5). Communities recognized by BC Treaty Commission (and the stage of negotiation) vs. Land Claims asserted but not yet recognized by BC government are catalogued. A value of (3) was given for all sites in negotiation because uncertainty exists. If a Treaty is in place a value of (5) was assigned as there is certainty in terms of who developers are negotiating with and the conditions of the claim area. Non-negotiated area or areas withdrawn from negotiations were ranked less favourably because of the uncertainty and longer time frames required to understand the local situation and move a development forward. Community action spearheaded by certain communities that may be favourable to Direct-use development was valued; however, Community activism against development was viewed as an additional hurdle. In these activist Communities it will take additional time and resources to resolve and understand the local situation. In the case of Direct-use applications, the local impacts are generally less, but any development that involves a small community can be disruptive and have unexpected or unwanted consequences. Visual considerations, tourism, and any traditional use remarks were added if available. In general this section on Community was viewed from the perspective of a developer being able to work efficiently and effectively with the local community. The expanded results can be found in Appendix **C**.

Resource included Factors **A** Resource; **B** Resource Risk; and **M** Maps, and was weighted a (5). Of these sections, all areas received 5 out of 5 for section **M** as relatively good topographic, geological and other mapping information exists for all the areas and it was not seen as a major detraction to development. On the Resource potential side of the valuation, sites with surface manifestations were ranked higher than those that have none. This is based on the fact that exploration for lower temperature resources (<80° C) is easier and less costly when there are well defined surface targets. Areas where there has been significant surface geology and even in some cases subsurface drilling (c.f. Clarke Lake and Jedney) were given higher values reflecting the lower cost of exploration resulting from known targets.

Roading Access & Constructability was weighted a (3) and included the results from Factors **I** Water Rights; **J** Engineering; **K** Non-electrical Infrastructure (roads and habitation); and **N** Other parameters. Water rights are relatively straight forward to apply for once permitting is in place as long as there are no water disputes in the area. Since no known water disputes were found, all sites were valued (5) with a few exceptions due to site-specific circumstances (Appendix D). Under engineering, since there was no information on the type of system or structure to be installed all were valued based on the potential for issues dealing with access and remoteness such as getting construction material to the site. Access was also evaluated under Factor **K** where proximity to large communities (>50,000) and paved roads were given the highest values. Those sites with poor road and access conditions (such as water only, c.f. King Island) were given low values along with sites where new roadwork is likely required. Under Factor **N** Spatial Concentration of the local population and distance to market for prospective commodities were considered. Sites with larger local populations and closer markets were ranked more favorably.

Outcomes

The overarching finding of this project is the need to build community knowledge and research-capacity of geothermal resources in general. More emphasis should be placed on Direct-use geothermal resources and the economic development opportunities that these present. The telephone calls revealed that most communities have limited or no knowledge of geothermal resources within their area. This finding is similar to that of Kunkel (2014) who found that the limited knowledge impeded the ability of communities to answer research questions about geothermal resources. This 2014 study provided two teleconferencing geothermal 101 sessions, an energy forum, and a fieldtrip to Reno, Nevada to visit geothermal power plant sites in order to build community capacity to be able to answer research questions (Kunkel 2014). Through these activities Kunkel was able to develop some community capacity in the Cariboo and Chilcotin regions of BC to enable these people to answer the research questions presented. This was reflected in the level of knowledge of the Nazko First Nations in their ability to help refine the project's questionnaire (Appendix A) and in the level of their responses.

During the telephone calls, we drew attention to resource locations close to each of the communities. We received varied responses about different resource sites. For example, Siska Nation stated that the resource location is 3 hours away from them. Two of the communities, Stó:lō Nation and Tobacco Plains, stated that the resource sites are not within their traditional territory. The Kitselas Nation responded that they are already working with a geothermal resource developer (Borealis Geopower).

Despite the comprehensive information pack sent to the communities at the onset of this project, telephone interviews revealed that more information about geothermal resources and the exact location of these resources within the identified Direct-use geothermal project area was needed. There was little understanding of the exploration process required to identify resources; in particular where there are no surface manifestations. Relevant sections of the KWL and GeothermEx (2015) report were sent to communities who requested this information. This project thus evolved into one-on-one community capacity building rather than answering the research questions. Further in-depth community consultations with each community were unfortunately beyond the scope of this project.

The online survey was sent by email to 32 communities. Of these 32, three completed survey responses were received and one was completed by an interview process. The three First Nations who responded were the In-Shuck-ch First Nation, the Tahltan Nation and the Nazko First Nation. These three groups are aware of geothermal resources within their traditional territories and provided responses to the survey

questions. In addition, Valemount, well-versed in geothermal development potential, responded to the survey. The survey site remained open until the end of March but no late submissions were received.

The face-to-face interview with the Nazko Band yielded more information. The interviewers, Dr. Kunkel and Ms. Hjorth, were able to explore each question in depth. The interviewees were also able to ask questions to clarify some of the interview questions in addition to providing more information about what the data would be used for. The face-to-face interview approach is a preferred method when working with Aboriginal communities.

The need for geothermal resource knowledge and building capacity within communities became evident from the telephone calls made. For this reason, the need for the *Roadmap* was identified early on in the process. The lack of community knowledge in this area meant that the majority of the people contacted were unable to answer the research questions. However, this does not mean that there are no traditional ecological knowledge or community stories pertaining to geothermal resources within the communities. Further consultative work would be required to understand local ecological knowledge and what other ways the Aboriginal communities use geothermal resources. Additionally, the amount of research information gathered was enough to provide descriptive and technical information about potential uses in BC for the *Roadmap* but was not enough to provide meaningful analysis.

The secondary data gathered as part of this project is comprehensive and provided useful information about all the communities. These data contain some traditional land use information for communities close to the resource sites. It should be noted that the secondary data gathered about communities primarily captured information at a point in time; some sites had not been updated for more than a year. Resource developers are advised to consult with communities and to seek out more up to date information prior to any development activity. The outcome of this project also does not imply consent to any development activities from any of the communities represented in this report.

Carbon Credits Proposal

In completing the GDDM the question of carbon credits came up. In 2007 the Province, the Union of BC Municipalities (UBCM) and local governments agreed, through the Climate Action Charter, to collectively take action on climate change by reducing greenhouse gases. The Greenhouse Gas Reduction Targets Act (2007) sets a province-wide reduction target of 33% from 2007 levels by 2020. Many communities have an Official Community Plan (OCP) that includes GHGE reduction targets. Some communities, for example Terrace, have even more ambitious targets than those stated in the Charter, but few have made significant progress on reducing GHGE through Direct-use geothermal resources that might be near at hand. The municipalities need assistance assessing and creating an action plan that includes geothermal energy. In 2008, new legislation was passed that requires every community to have a stated GHGE reduction target.

It is widely accepted that there is a direct and negative correspondence between power generation and carbon emissions, with CO_2 and CH_4 as well as soot and other particulates as the primary negative (undesirable) compounds. Most of these compounds are associated with the burning of hydrocarbons such as coal or natural gas, but to a lesser degree they are produced by decaying biomass in hydroelectric facilities as well as propane which is commonly used in remote ‘off grid’ locations where electricity is extremely expensive or there is no natural gas source available.

BC has taken the lead in establishing a carbon ‘tax’ assessed on fuel use by motorists in the Province. The incidence of the tax is not prohibitive, but still provides a reminder and incentive to vehicle owners

to conserve use and seek out energy efficient transportation alternatives. Since the Province has shown leadership in this area, creating a link between geothermal resource development and carbon offsets may provide mutually beneficial incentives both for land owners as well as public officials, in addition to support through the ICE and FNCEBF programs.

The Proposal

There are two communities in BC with geothermal resources available for Direct-use applications. They are Valemount and Harrison Hot Springs, with ~1,200 and ~1,600 year round residents, respectively. Both serve a tourist trade that sees transient populations increase to over 3x the resident population, with a corresponding spike in seasonal demand for electricity and heating. Electricity is delivered by BC Hydro and is derived from a combination of hydroelectric, natural gas-fired generation and some coal-fired generation in the system wide mix. Gas for heating purposes is delivered as propane or Liquified Propane Gas (LPG) by truck to individual users.

Both communities could serve as a model for creating carbon offsets by using geothermal heat to diminish reliance on both electric and propane sourced heat. The model would allow those who retrofit or install new geothermal heat facilities to calculate the lowered demand for fossil fuel derived heat (comfort and cooking as well as some industrial uses) and apply to the Province for either a credit that could return some fraction of the carbon tax collected by the Province or to apply for subsidized loans to develop local infrastructure and facilities.

This type of program does not exist currently, but fits with the objectives of the Provincial government. We believe that the program and a demonstration of the utility of the concept could be designed to show how a combination of reduced demand for hydrocarbon energy sources replaced by a non-carbon source such as geothermal direct heat creates valuable GHGE reduction effects in the atmosphere and enhances the existing carbon tax program in the Province.

This model would have to be designed and implemented at the local level to demonstrate the value; however, the benefits ranging from lower cost of energy for residents and commercial owners, combined with overall net gains in GHG emissions could recoup all program costs of implementation. This is especially true since the implementation of GHGE reduction targets for communities.

We believe such a proposal, supported by the two communities would elicit interest and support from the Province and if successful could be expanded to other communities with positive affect.

Recommendations

Community visits would be an appropriate follow-up at the end of the study along with information sharing teleconference call to:

Discuss outcomes with participating communities:

Disseminate information about next step(s)

Introduce Geoscience BC as an information source to participating communities

Disseminate copies of the *Roadmap* and other informational materials

There are some Direct-use developments that have shown that successful, small scale projects are possible in remote locations. For example Chena hot springs, Alaska, is a successful, multi-use facility operating in a remote location. Fairbanks (population in 2013 was 32,234), is located approximately 100

km from Chena hot springs and the facility attracts many visitors with special tourist attractions including Aurora Borealis tours and an Ice Museum. Geothermal waters are used to heat greenhouses

to grow vegetables for guests. Chena has the benefit of year-round access via a paved, two lane highway, and has many of the hallmarks of an economically successful venture employing 45 people. Using it as a case study and as an example for other communities contemplating Direct-use projects might be beneficial in helping communities understand what a multiuse geothermal development might look like. In addition the following recommendations are made:

1. Regional workshops held in northern, central, south western and south eastern BC are critical. These workshops would introduce communities to the potential resources that are available and what they might be utilized for. Copies of the *Roadmap*, GDDM and other resource material should be supplied to attendees and they would be provided with direction as to the variety of possibilities for Direct-use geothermal and how to work out a basic economic development plan. These regional workshops should then be followed-up with community workshops where a hands-on development framework could be created. Part of the workshop structure could include a system put in place to:
    a. Raise awareness to the local communities to the presence and benefits of geothermal energy as a heat source.
    b. Providing educational activities to the general public and to school educators about geothermal Direct-use applications.
    c. Providing strategies for increasing local infrastructure development that would boost the local economy and may also provide a positive factor for the economic evaluation of particular Direct-use applications.
    d. Partnering with local community leaders to spread useful and factual information about the advantages of Direct-use applications.
2. First Nations' should be encouraged to apply for funding through the FNCEBF to help in preliminary assessment of their region and evaluate Direct-use geothermal options. Other communities should seek financial assistance through the Province's Innovative Clean Energy fund (ICE), the Economic Development Capacity Building fund, and the new federal funds announced in the 2016 Federal budget which would be available through Indigenous and Northern Affairs Canada. For northern communities the links are through: http://www.northerndevelopment.bc.ca/news/innovative-clean-energy-fund-now-accepting-proposals/ and http://www.northerndevelopment.bc.ca/funding-programs/capacity-building/economic-development-capacity-building/.
3. A model for creating carbon offsets by using geothermal heat to diminish reliance on both electric and propane sourced heat should be considered. The model would allow those who retrofit or install new geothermal heat facilities to calculate the lowered demand for fossil fuel derived heat (comfort and cooking as well as some industrial uses) and apply to the Province for either a credit that could return some fraction of the carbon tax collected by the Province or to apply for subsidized loans to develop local infrastructure and facilities.
4. Putting a plan in place to partner with local governments and ultimately the Provincial government to implement a province-wide program using, for example, the US Geothermal Technologies Program (part of the US Energy Efficiency and Renewable Energy division) as a potential model.

Other Parameters

As part of the Project, Dr. Jacek Majorowicz reviewed and updated the existing heat flow map. The map was used as the basis for Figure 1 and to reconfirm the 18 focus areas as well as the distribution of known hot springs (Woodsworth and Woodsworth, 2014)

Dr. Glenn Woodsworth and Mr. Ron Yehia reviewed the hot spring and structural information now available. Mr. Yehia reviewed the geochemistry provided by KWL and GeothermEx (2015) and updated locations for which additional relevant information was available. Previous proprietary information obtained by Sierra Geothermal, Western Geothermal was made available by Polaris Infrastructure.

These updated data sets did not change the focus regions or communities.

Research ethics and Tri-Council policy statement

This project was guided by the 2014 Canadian Tri-Council Policy Statement on the Ethical Conduct for Research involving Human Subjects. The three federal research agencies - the Canadian Institutes of Health Research (CIHR), the Natural Sciences and Engineering Research Council of Canada (NSERC), and the Social Sciences and Humanities Research Council of Canada (SSHRC) - jointly introduced the ethics framework as a guideline for research and researchers.

The application of the policy statement included informed consent and privacy and confidentiality of research participants and information. Furthermore, the policy statement and its application to Aboriginal peoples formed the basis of engagement with First Nations communities. Aboriginal principles such as ownership, control, access, and protection of community owned data and information was respected. A statement of the ethics protocol adhered to has been included in this report (see Appendix A).

Project Funding

This project was jointly funded by Geoscience BC and the BC government's ICE Fund. Geoscience BC is a non-profit organization supported by the Province of British Columbia that generates earth science information in partnership with First Nations, the resource sector, universities, governments and communities to encourage investment and enable informed land use decisions for the benefit of all British Columbians. The ICE Fund is a Special Account, funded through a levy on certain energy sales, designed to support the Province's energy, economic, environmental and greenhouse gas reduction priorities, and to advance B.C.'s clean energy sector. Geoscience BC gratefully acknowledges the financial support of the Province of British Columbia.

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APPENDIX A:
Information Package and Questionnaire

INVESTIGATING THE POTENTIAL FOR DIRECT-USE GEOTHERMAL IN BRITISH COLUMBIA – A NEW GEOSCIENCE BC PROJECT

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Project Information for communities

Geothermal energy in British Columbia has long been discussed as a potential renewable (i.e. green) energy source for the province. The 2015 study by Kerr Wood Liedel and GeothermEX evaluated 18 geothermal manifestation sites and provided more detailed information regarding 11 sites deemed "favourable" for electrical generation. They reported that the combined potential for the 11 sites was up to 400 MWe of power. However, the hurdle for economically viable geothermal electrical power generation development is not just the confirmation of suitable resources, but also the need to identify acceptable financial and economic factors. Electrical generation can have significant long term pay-back but it entails very high up-front costs. In addition, the length of time to develop a resource can also be long-drawn-out and the exploration required for development is complex and costly. However, 'Direct-use' applications at lower temperature are easily attainable resources than electricity generation. Direct-use applications have simpler and lower cost of exploration. This study seeks to quantify and evaluate the potential for Direct-use in British Columbia communities and create a 'Road-Map' for development opportunities. Figure 1 below shows the known application of geothermal resources at different temperatures. Some lower temperature Direct-use applications include soil warming, greenhouse gardening, fish and aqua culture, spa, food processing, mushroom culture, pulp and paper processing, and lumber drying.

Geoscience BC is funding the joint proposal by Tuya Terra Geo Corp (TTGeo) and Geothermal Management Company Inc. (GMC) to carry out this study. TTGEO is a BC based company while GMC is based in Colorado. The two companies have combined expertise in various aspects of the project and will complete the evaluation and also document the results. The project will be carried out over the next six months with products expected in mid-2016.

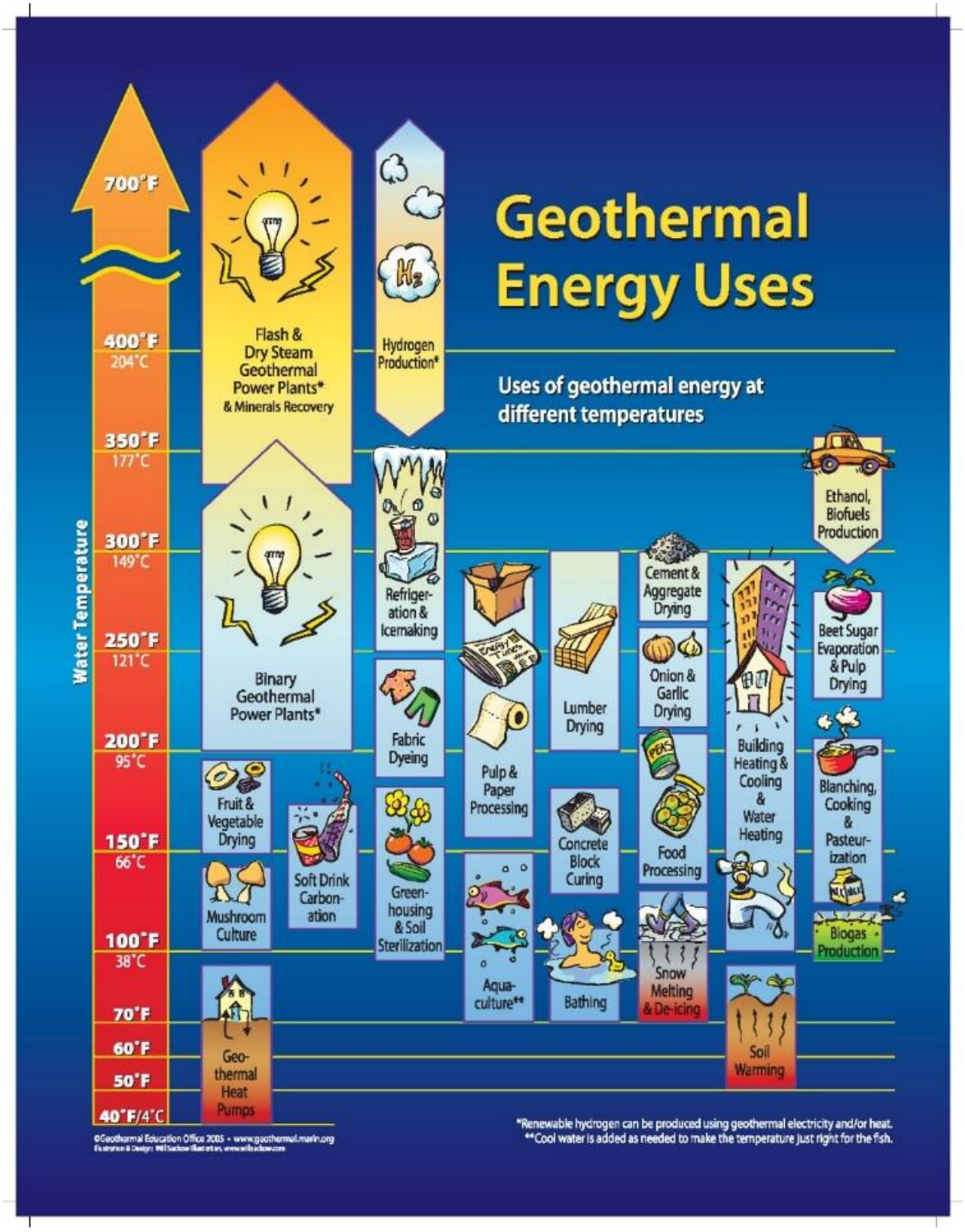

Figure 1: Known uses of geothermal resources

Methodology and Project Structure:

This project will be divided into three phases as summarized below.

Phase 1: Identify regions and communities in British Columbia with potential for Direct-use geothermal energy development.

As a first step, a list of existing British Columbia geoscience data sets useful for the evaluation of Direct-use geothermal energy has been compiled. The team will build on the existing geothermal data collected for the 18 locations studied by Kerr Wood Leidal and Geothermex. These sites are Canoe Creek – Valemount, Clarke Lake, Clearwater Volcanic Field, Iskut, Jedney, King Island, Kootenay, Lakelse Lake, Lower Arrow Lake, Meager Creek/Pebble Creek, Mt. Cayley, Mt. Garibaldi, Silverthrone - Knight Inlet, Nazko Cone, Okanagan, Sloquet Hot Springs, Sphaler Creek, Upper Arrow Lake. The data will be analysed and compared with the results of some earlier studies.

As a first step the eleven sites for which detailed economics calculation were completed and additional development information was compiled are being considered as areas with potential for Direct-use geothermal. These sites are Canoe Creek, Valemount, Clarke Lake, Kootenay, Lakelse Lake, Lower Arrow Lake, Meager Creek/Pebble Creek, Mt. Cayley, Okanagan, Sloquet Hot Springs, and Jedney. The list of communities in these regions will form the basis for further study of Direct-use potential.

Phase 2: Review of community and technical information gathered.

During this phase, all communities in areas surrounding the Canoe Creek, Valemount, Clarke Lake, Kootenay, Lakelse Lake, Lower Arrow Lake, Meager Creek/Pebble Creek, Mt. Cayley, Okanagan, Sloquet Hot Springs, and Jedney sites will be contacted. Semi-structured interviews will be conducted to gather data about land use and economic development interests of these communities.

During this phase, some community research capacity would be built. Community knowledge and awareness of geothermal resources and opportunities presented would be increased. Data gathered during interviews will be reviewed along with technical information gathered for the sites.

Phase 3: Summarizing and analyzing the results and completing the Geothermal Direct-use Road Map.

During this phase, the final report will be produced. The report would include conclusions and recommendations regarding the next steps for assisting communities that may wish to move forward with development planning. The Road Map will include, but is not limited to:

1) Conduct of ground-surface based activities designed to characterize the resource (geology and geochemistry, possibly some geophysics depending on cost, location and other circumstances);

2) Acquisition of land control;

3) Information about First Nations consultation, acquisition of all federally, provincially, and locally required permits;

4) The cost of drilling shallow thermal gradient holes;

5) The cost of drilling of either slim-hole(s) or production/injection well(s) (depending on the amount of money available);

6) Testing of wells;

7) Design and construction of facilities for beneficial, commercial use and disposal of the produced thermal fluids; and

8) The cost of transporting the Direct-use product(s) to the potential end user(s).

Additional Information

Attached are the following documents which form part of this study:

- Appendix 1: Direct-Use Geothermal Resources In BC - Research Ethics Protocol
- Appendix 2: Direct-Use Geothermal Resources in BC - Participant's Interview Information Sheet
- Appendix 3: Direct-Use Geothermal Resources in BC - Participant's Consent Form for In-depth Interview
- Appendix 4: Direct-Use Geothermal Resources in BC - Discussions/Interview: Guide Questions

It is anticipated that through this study more information about geothermal resources and its Direct-use applications in British Columbia will become available. The final report will be publically accessible. The updated geoscience and development data, when combined with the Direct-use Road Map and community capacity building would assist communities and developers in carrying out successful Direct-use geothermal projects.

APPENDIX 1: DIRECT-USE GEOTHERMAL RESOURCES IN BC

RESEARCH ETHICS PROTOCOL

This document defines the ethics protocol in which the study will be carried out and how the publication of the findings will be handled. This protocol is guided by the 2014 Canadian Tri-Council Policy Statement on the Ethical Conduct for Research involving Human Subjects. The three federal research agencies - the Canadian Institutes of Health Research, the Natural Sciences and Engineering Research Council of Canada, and the Social Sciences and Humanities Research Council of Canada - jointly introduced the ethics framework as a guideline for research and researchers.

WHEREAS:

1. Titi Kunkel ("TK") and Leah Hjorth (“LH”) are working with Tuya Terra Geo Corp (“TTGEO”) to investigate Direct-use geothermal within identified BC communities.

2. The research will determine what Direct-use geothermal resources opportunities are available for communities for economic purposes.

3. The information will used along with publicly available data to develop a road map for Direct-use geothermal resources in BC.

4. The findings of this research will be documented in a report to Geoscience BC.

1 GUIDING ETHICAL PRINCIPLES

1.1 Respect for participants

The TTGEO and its representatives ("The Team") shall protect the cultural, mental, spiritual, physical and emotional interests of participants throughout the research process. This principle forms the foundation for all other ethical principles outlined below.

1.2 Respect for Free and Informed Consent

The Team shall comply with the exercise of individual and community consent. Consent would be achieved through a letter of consent or verbal consent from representatives of the community.

Participants have given free and informed consent when they have freely, without coercion or intimidation, agreed to participate in the study based on well-understood information regarding the research objectives and potential benefits and risks of participation. Objectives of the study include information regarding the ways in which the research results shall be published and how the participants will be informed of the results.

Continuing voluntary participation requires that participants understand that at any time their withdrawal of consent to the research project shall not result in penalty, including any loss of promised benefit, which are not contingent upon completion of participation.

Evidence of free and informed consent by the participant or authorized third party will be obtained in writing or recorded with name, date, and form of consent.

1.3 Respect for Vulnerable Persons

The Team will ensure that high ethical obligations are maintained regarding those who are vulnerable or lack decision-making capacity.

1.4 Respect for Anonymity and Confidentiality

The Team members shall not solicit confidential information; however, shall respect the participants' rights to anonymity and confidentiality if so required. This includes protection of access and dissemination of personal information.

1.5 Respect for Intellectual Property

The Team recognizes and acknowledges that the community has inherent rights to control and determine their proprietary interests in the collection, use, and storage and potential future use of data.

Individuals and/or members of the community will retain ownership of any traditional knowledge, cultural practices and traditions that are shared with the research team.

Other research data that does not pertain to traditional knowledge, cultural practices and/or traditions will be used in the study.

The findings of the research will be published as a report and submitted to Geoscience BC. This report could be made publicly available Geoscience BC.

The Team will ensure that each community participants have *reasonable* opportunity to participate in the interpretation of data and review of conclusions drawn from the research to ensure accuracy and sensitivity of interpretation.

1.6 Minimizing Harm and Maximizing Benefits

The Team will ensure anticipated benefits outweigh potential harms when conducting the research. In the process of conducting research, The Team will ensure that participants are not subject to

unnecessary risks or harm and shall be obligated to assist the participant in reducing or eliminating any adverse effect that may arise.

1.7 Access

Research participants will be able to obtain copies of material and any research findings and reports by prior arrangements with The Team. A summary of findings will be given to all participants.

APPENDIX 2: DIRECT-USE GEOTHERMAL RESOURCES IN BC

PARTICIPANT'S INTERVIEW INFORMATION SHEET

Researcher: Ms. Leah Hjorth
Phone No:
E-mail:

Researcher: Dr. Titi Kunkel
Phone No: 250.XXX.XXXX
E-mail: titi.kunkel@alumni.unbc.ca

Researcher: Dr. Catherine Hickson
Phone No: 604.XXX.XXXX
E-mail: TTGeo@telus.net

Project Information: Purpose, Benefits, and Potential Risks

Purpose of research: The purpose of this research is to find out more information about Direct-Use geothermal resources that are available within communities in BC. The aim of the study is to gather as much information about the available Direct-Use geothermal resources, provide information to communities about possible uses, understand community aspirations, and develop a detailed road-map for development. This study is being carried out by Tuya Terra Geo Corp Inc (TT Geo). The Funds for this project was received from Geoscience BC.

How communities have been chosen: In 2015, Kerr Wood Leidal and Geothermex, concluded a study for Geoscience BC on the viability of electricity generation for known geothermal resource areas. These areas were Canoe Creek – Valemount, Clarke Lake, Clearwater Volcanic Field, Iskut, Jedney, King Island, Kootenay, Lakelse Lake, Lower Arrow Lake, Meager Creek/Pebble Creek, Mt. Cayley, Mt. Garibaldi, Silverthrone - Knight Inlet, Nazko Cone, Okanagan, Sloquet Hot Springs, Sphaler Creek, and Upper Arrow Lake. This study is for eleven of these sites are now being considered as viable locations for Direct-Use geothermal resources. These sites are Canoe Creek, Valemount, Clarke Lake, Kootenay, Lakelse Lake, Lower Arrow Lake, Meager Creek/Pebble Creek, Mt. Cayley, Okanagan, Sloquet Hot Springs, and Jedney. This study is to provide detailed economics and additional information which is required to develop a 'road map' for development options.

Benefits of this Project: This project will identify locations with good potential for geothermal resource Direct-Use applications. This project will compile an inventory of current and planned Direct-Use projects as well as provide communities with a "road map" for evaluating their resource as the first steps towards development. This tool-kit will provide guidance for communities as to how to move forward on Direct-Use projects, addressing all technical and non-technical aspects.

The project findings, conclusions, and recommendations will be summarized in a report from having a table of contents, supporting data sets (portable hard drive), references, completed community knowledge matrices, an exploration road map, and methodology. It will also include a discussion of any issues encountered in the data analysis, assumptions made, and corresponding limitations on the interpretation of the results based on sparse data, community engagement limitations or other factors. Spatial data collected will be compiled at a scale suitable for web hosting and/or distribution. Documents and other types of data will be compiled and indexed for future reference on a community by community basis.

The community data collection process is designed to engage local communities, thereby increasing awareness and knowledge of geothermal resources in their area. This study will use inclusionary methods such as semi-structured interviews to increase community knowledge of Direct-Use geothermal resources. A benefit of participating in this study is that the outcome of the project outcome would provide information which can be incorporated into community economic development plans.

Potential risks of this project: While this study is not a consultation for resource development and will not be soliciting information about geographic locations of communities' sacred sites or traditional use areas, it is possible these resources are at close proximity to those areas. In such instances, the study will note these other uses but not provide the geographic locations of such. Furthermore, communities are not obligated to provide details of traditional land use or sacred sites.

What questions will interviewees be asked? Interview questions have been designed to provide information required to put together the Direct-Use geothermal resources road map for BC. Questions asked will be based on the attached 'In-depth Interview Guide Questions'. Personal or confidential information will not be solicited.

Voluntary nature of their participation: Participation in this research is completely voluntary. However, participation will be beneficial for all communities as this study provides opportunities both for current and future discussions about geothermal resources available in the area and the different considerations for community uses. If a community is not available for participation or chooses not to participate, known and publicly available data will be compiled for the area. This will not affect the community's involvement in future discussion about geothermal resources in the area.

Project Team Members

TT Geo has assembled an impressive team of experienced researchers in the community engagement and Direct-Use geothermal field. With their knowledge of green-field geothermal exploration, depth of experience, intimate knowledge of the geology of British Columbia, and highly advanced skills in community engagement, they will be able to execute the project efficiently. Each member brings a specific expertise to this highly qualified team of geothermal practitioners.

- **Dr. Catherine Hickson P.Geo. – Project Manager and Science Co-leader**

Dr. Catherine Hickson will provide overall project management and team leadership. Dr. Hickson is the President of Tuya Terra Geo Corp. and has more than 35 years' experience in geology, geothermal energy and managing high performance, multidisciplinary teams. For twenty-five years she worked for the Geological Survey of Canada (GSC) in various capacities including executive roles. She began her career with the GSC working on the Mount Meager geothermal project and other heat flow projects. In 1992, she was the scientific authority for the Geothermal Map of British Columbia. In 2008, she joined a private sector energy company, Alterra Power Corp. which focused on geothermal energy exploration and development. She built a global portfolio of green-field concessions for the company, several of which are now partnered to other companies for advanced exploration, including the global geothermal giant, Energy Development Corp. (Philippines). In 2013, she left the company when they ceased green-field exploration. In the last two years she has built a strong client base of Canadian and international companies and continues to work in geothermal energy. She has published numerous scientific papers including a recent publication on "The Geothermal Exploration and Development Process: Graphical Representation Path to Optimal Decision Making" presented at the Geothermal Resources Council meeting, October 2014, Portland Oregon.

- **Dr. Titi Kunkel – Science Co-leader**

Dr. Titi Kunkel has over 25 years of international training and education project experience. Her work in the last ten years has primarily been in the Cariboo and Chilcotin regions of BC, working with Aboriginal communities. She received her Ph.D. from University of Northern BC in 2015 and continues to work with the university developing and delivering programs for rural and remote communities. Dr. Kunkel's dissertation assessed the compatibility of geothermal resource development and Aboriginal values within the Nazko and Xeni Gwet'in First Nations communities. Her work sheds new light on Aboriginal values in the region and the significance of these in economic development. She sits on the Board of Directors for Community Futures Development Corporation for the North Cariboo and the Nazko Economic Development Corporation. She has led numerous community-based research projects for Aboriginal communities in the region. Of note is her work with the Tsilhqot'in Nation communities to identify Aboriginal values in an area of cultural interests and significance to the people. She presented her findings at the two Federal Environmental Assessment panels (2010 and 2013) and at the World Mining Congress of 2013 in Montreal.

- **Ms. Leah Hjorth - Research Associates**

Ms. Leah Hjorth has a BA in Education from the University of British Columbia and she is a member of the Nazko First Nation. Ms. Hjorth has been identified as a Research Associate for this project because of her work with Aboriginal communities in the Cariboo region. Ms. Hjorth has worked with Dr. Kunkel on community-based research projects using questionnaire surveys and semi-structured interviews. In addition, she worked with Drs. Kunkel and Hickson on a project to investigate geothermal resource potentials in the Nazko area. Ms. Hjorth will be

working with Dr. Kunkel to compile community interests and use data in areas with high potential for geothermal direct-use resources.

- **Mr. Gerald W. Huttrer – Direct-Use Expert and Science Co-leader**

Mr. Gerald W. Huttrer is President of Geothermal Management Company, Inc. (GMC). GMC is a consultancy, founded in 1985, specializing in provision of services to the geothermal industry. These are focused on the geoscientific aspects of low, medium, and high temperature projects that have been conducted in 47 geothermally prospective countries. Mr. Huttrer is the sole employee of GMC, however he frequently associates with other geothermal experts to establish a team that will be optimally qualified to undertake a specific project as in this case.
Mr. Huttrer has collaborated with Dr. Lund, and Ms. Boyd on several Direct-Use projects in the past. Generally, Mr. Huttrer studies the geologic and sub-surface situations. Over his more than 40 years in the geothermal industry, Mr. Huttrer has gained a wide range of Direct-Use experience including, but not limited to: space heating and cooling, greenhouse and aquaculture pond heating, industrial applications, geothermal (ground-source) heat pumps, snow-melting, and combined heat and power facilities.

Mr. Huttrer is a geothermal geologist with a B.A from Dartmouth College and an MS from the University of Washington. He has worked in the geothermal industry since 1969 and has conducted geothermal studies for heat-pump-related, Direct-Use, and electric power generation internationally for entities including the U.S. and foreign governmental agencies, private and corporate entrepreneurs, investment banks, petroleum and mining companies, tribal organizations, and Multi-Lateral Development Banks. He is a past president and multi-term director of the Geothermal Resource Council (GRC), a founding member of the International Geothermal Association and is a recipient of the prestigious Aidlin Award from the GRC. Mr. Huttrer's Direct-Use projects include evaluation of the potential for economic development of low to medium temperature resources in: the entire state of Alaska (for the National Renewable Energy Laboratory), the city of Steamboat Springs, Colorado, the City of Glenwood Springs, Colorado, the City of Ouray, Colorado, the City of Pagosa Springs, Colorado, Fallon Naval Base, Nevada, the City of Banya Luka, Bosnia-Hertzegovia, and the whole of the Western United States (for Geoterma, Paris-Nord, France).

- **Dr. John Lund PE – Direct-Use Expert**

Dr. John Lund is one of the world's leading geothermal Direct-Use expert with more than 45 years in the geothermal industry. He holds BS and PhD Civil Engineering degrees from the University of Colorado and an MS Civil Engineering degree from the University of California, Berkeley. Dr. Lund was associated with the Oregon Institute of Technology Geo-Heat Center from 1980 through 2010 and held Professorial, Dean, and Director Positions throughout these 30 years. He has lectured to governmental, academic, industrial, and private audiences all over the world and has innumerable geothermal publications regarding all surface-related aspects of

Direct-Use. Dr. Lund is a past president of the Geothermal Resources Council and of the International Geothermal Association.

Dr. Lund's most recent presentations include: a four-lecture series on Direct-Use applications to the 2014 ASHRAE Conference in Salt Lake City, Utah, six lectures on Direct-Use applications to the Canadian Geothermal Energy Association (CanGEA) in Calgary in March 2014, and a Keynote speech/overview of geothermal Direct-Uses to the Asian Pacific Energy Conference in Taipei, Republic of China in June 2013. Dr. Lund also has done extensive field work in Klamath Falls and Lakeview, Oregon as well as in Steamboat Springs, Glenwood Springs, and Pagosa Springs, Colorado.

- **Dr. Glenn Woodsworth P.Geo. – Structure, Hot Springs of British Columbia**

Dr. Glenn Woodsworth has over 45 years geological experience in British Columbia and brings to the project a thorough understanding of the geology of British Columbia. After receiving his Ph.D. from Princeton University, he joined the Geological Survey of Canada (GSC) as a Research Scientist. His work focused on bedrock geological mapping and structural and metamorphic studies at various scales, and on regional geological syntheses of Cordilleran geology. He has a long interest in hot springs and was a contributor and editor of the Fairbank and Faulkner's 1992 Geothermal Map of British Columbia. Since leaving the GSC, he has consulted on various geothermal and regional geology projects within B.C. He was the first scientist to call attention to the geothermal potential of the Knight Inlet/Hoodoo Creek area. Dr. Woodsworth has published over 120 papers, reports, and maps on the many aspects of Cordilleran geology, and his *Hot Springs of Western Canada* (3rd edition, 2014) is the standard work on the topic.

- **Dr. Jacek Majorowicz – Heat Flow**

Dr. Jacek Majorowicz is a global expert in heat flow. He brings to the team a deep understanding of the subsurface thermal regime as determined through boreholes and other data. He has studied thermal problems on a variety of scales applied to geothermal systems including the state of the lithosphere, geothermal energy of the sedimentary basins, engineered geothermal systems (EGS), and thermal maturation-basin studies. Previous works have included heat flow and magnetotelluric work done for the Cordillera and sedimentary basins in B.C. which included the B.C. part of Western Canadian Sedimentary Basin, and Bowser and Nechako basins in the Intermontane Belt. The majority of these studies and resulting study reports have been published as scientific papers in top geophysical and geological journals in America and Europe. Of note is his work on enhanced geothermal systems in Canada and the identification of high potential regions.

- **Dr. Michal Moore – Energy Economist**

Dr. Michal Moore is one of the leading thinkers on energy economics in North America. His major research areas and interests include the operation and oversight of energy markets, including the interaction of oil and gas and electric systems. Dr. Moore's recent research has focused on the integration of geothermal and solar energy facilities with the national grid in Australia and in Canada. He holds academic appointments in energy economics and systems engineering at both Cornell University and the University of Calgary. He is the current Area Director of Research for Energy and Environment at the School of Public Policy in Calgary and works with researcher faculty at Carleton University on a broad range of public education and literacy projects oriented to improving public perception and understanding of energy systems. He recently co-authored a major report on geothermal resource potential in Australia, and was a co-author of the first report to comprehensively identify geothermal resources throughout Canada. Dr. Moore is currently teaching classes in renewable energy technologies, and developing a low temperature geothermal system to assist in neutralizing pathogens in human waste for developing nations.

- **Mr. Ron Yehia – Geochemistry and Geomatics**

Mr. Ron Yehia is an experienced geothermal and grassroots exploration geologist. Mr. Yehia was the Canada Exploration Lead at Vancouver-based Alterra Power, where he was responsible for planning and managing exploration in Western Canada as well as managing the geoscience hardware and software. At Alterra, he also participated in overseas exploration including assessment of various exploration tools and techniques. Prior to Alterra, Mr. Yehia was an exploration geologist at Ormat Technologies based in Reno, Nevada, where additional duties included responsibility for British Columbia exploration and as Manager of the Resource Group geodata. Currently, Mr. Yehia is consulting as an exploration geologist offering expertise and services in real-time hydrogeology results acquisition, and geoscientific solutions specializing in open source tools. He has also compiled a GIS database of geochemistry results for British Columbia. This is available online at:
http://www.arcgis.com/home/item.html?id=cebc4e70ad4c48fd8314a681ae65f09c

- **Ms. Toni Boyd – Geomatics Specialist and Direct-Use Expert**

Ms. Toni Boyd holds BSc degrees in Civil Engineering Technology and Civil Engineering from the Oregon Institute of Technology (OIT). She has been involved in all aspects of geothermal Direct-Use projects for more than 21 years and rose from her initial Lab Testing Technician position at OIT to Senior Engineer and Acting Director. Ms. Boyd has extensive computer experience and has edited and been responsible for graphics on numerous OIT and international publications. She is also an expert in creation of geothermal data bases both for resources and for surface applications. She is a multi-term director of the Geothermal Resources Council (GRC) and was the Direct-Use Chair of the GRC Annual Meetings from 2001-2015 as well as for the World

Geothermal Congresses in 2005, 2010, and 2015. Ms. Boyd has also authored and co-authored a great many articles and publications regarding geothermal Direct-Use.

- **APEX Geoscience Ltd. – Geology and Geomatics**

  Tuya Terra Geo Corp has subcontract APEX Geoscience Ltd. as an integral part of the team to provide geomatics support for the project. APEX has been providing geological consulting services to small and large exploration companies around the world for more than 20 years. APEX brings to the project their experience in British Columbia exploration through their highly experienced team of geoscientists and sophisticated software and database management expertise. They also have considerable experience in technical reporting, geological modelling and resource estimation services.

  Through Apex, Ms. Yuliana Proenza P.Geo. will be engaged. Ms. Proenza is a geologist and a geomatics specialist with APEX Geoscience Ltd. She has a B. Sc. in Earth & Planetary Sciences from McGill University followed by a Master of Engineering degree in Clean Energy Engineering from University of British Columbia in 2012. Her thesis built a conceptual model for the Mount Meager geothermal system. She is an expert in GIS, database management, proficient in Geographical Information Systems (ArcGIS and MapInfo), 3D modelling and exploration targeting (Micromine, Leapfrog 3D, Maptek, Vulcan, Gemcom Surpac) and data management solutions (Microsoft Access).

Names and phone numbers of people to contact in case questions arise or you need more information: If you have any questions, please feel free to contact me, Titi Kunkel, at 250 XXX XXXX or Catherine Hickson at 604 XXX XXXX.

You will receive a copy of the summary sheet when this research is has been completed.

You will be given a copy of this information sheet and a copy of your completed and signed consent form.

Thank you very much for your participation. I look forward to working with you throughout the research period. Your participation is invaluable.

Sincerely

Dr. Titi Kunkel

APPENDIX 3: DIRECT-USE GEOTHERMAL RESOURCES IN BC

PARTICIPANT'S CONSENT FORM FOR IN-DEPTH INTERVIEW

You have been asked to participate in a research for the purpose of creating a development road map for direct-use geothermal resources in BC. Information from this interview will be used as the basis of a written summary which will be included in a report submitted to Geoscience BC.

Please read and note your agreement by circling 'Yes' or 'No' in the following questions:

I understand that I have been asked to be in a research study.	Yes	No
I have received and read a copy of the attached information sheet.	Yes	No
I understand that participating in this interview entirely is voluntary.	Yes	No
I am free to terminate the interview at any time without any cause or reason.	Yes	No
I understand that the results of the interview may be used in developing a road map for direct-use geothermal resource development in BC.	Yes	No
I understand the benefits and risks involved in participating in this study.	Yes	No
I have had an opportunity to ask questions and discuss this study.	Yes	No
I give my permission for written notes to be made during the interview.	Yes	No
I give permission for my quotes to be used in the final report document.	Yes	No
I understand that I do not have to give confidential information.	Yes	No
I give permission for my name to be used in the final report document.	Yes	No
I understand that if I require more information regarding the case study, I may contact the lead researchers or any member of the research team.	Yes	No

I understand that I will have the opportunity to review the written summary before the final document.	Yes	No
The issue of confidentiality has been explained to me	Yes	No
I understand who will have access to the information I provide	Yes	No

This study has been explained to me by Leah Hjorth or Titi Kunkel. By signing this form, I am providing written consent to participate in the direct-use geothermal resources in BC project and I understand all the terms listed above.

Participant's Signature:	Authorized Signature:
Participant's Name (please print):	Authority given by (please print name):
Date:	Date:

I believe that the person signing this form understands the study. This participant has been provided with all information, and all concerns and questions have been address in relations to their voluntary participation. I have confirmed that I have permission from a person in authority to interview this participant.

Signature: _____ Date: _____

Researcher's Name: _____

APPENDIX 4: DIRECT-USE GEOTHERMAL RESOURCES IN BC

DISCUSSIONS/INTERVIEW: GUIDE QUESTIONS

Geothermal Resource Knowledge and Cultural Significance:

This study is looking at how geothermal heat can be used directly to benefit communities in your area. Geothermal heat is heat from the ground which comes to the earth surface. Manifestation of this heat can include hot springs or geysers. There have been studies which show that you have some heat in your area at depths which is accessible. We are seeking to put together a Road Map for developing some of these heat resources to benefit your community. Do note that this study does not constitute a community consultation for resource development. All development activities still have to follow the community's consultation process.

Name of interview participant: _____

Name of community: _____

Interview date: _____

Interviewer: _____

General geothermal information:

This section is about the general awareness of geothermal resources and its use in the area.

1. **Are you aware of uses of geothermal heat (heat from the earth) in your area?** For example people using hot springs for spa or lakes which do not freeze in winter? These seem to be some of the common manifestation of geothermal resources.

2. **Are you aware of other economic uses of geothermal heat – maybe cultural healing bath or others?** – such as to heat greenhouse gardens which could increase crop production, ground heating in order to get produce to market faster, heating large pools for spa as part of eco-tourism package, and for fish hatchery and fish farming. The hot water can be used for drying vegetables and spices. In some cases the hot water can be used for drying lumber.

3. **Do you know of other uses of heat from the earth/ground?** Are there cultural meanings or interpretation of these?

Indigenous laws and governance:

The questions in this section are to capture information about Indigenous laws and governance, and community and economic development in the resource location.

4. The following communities have surface rights in the area: (list of other communities in an overlap area). **Have we missed any other community or group of people who use the area and have rights for example Aboriginal Rights or Aboriginal Title?**

5. Land claims: **Is this community going through Treaty?**
   If yes, what stage are they?
   If no, is there any land claims going on? Court case, etc. …

6. **Do you have a protocol for community consultation?** If yes, where can we find this information?
   If no, what is your consultation process?

7. **Is there a shared community consultation process for all the communities in the overlap area?**
   If yes, where can we find this information?

General community and economic development information:

This section is to capture information about community and economic development interests in the area.

8. We are interested in what your community economic development plans are and perhaps geothermal heat can help with some of these. **Tell me more about what your community is doing for economic development.**

9. **Are there community owned businesses or joint ventures?** If no, are there interests in these?

10. **What is the employment situation at the community?**

11. **Where do most people work?**

12. **Do people worry about food security?** For example, bringing in food from the nearest town (how far is the nearest town from the community?)

Traditional use information:

This section is for information about traditional activities in the area required for sustenance rights.

13. **Do people hunt around (resource location) area?** If yes, is it a family's hunting ground? If no, are there other areas or hunting grounds close by?

14. **Do people do some trapping in the area?** If yes, about how many people? If no, are there trap lines nearby?

15. **Do people fish in local lakes?** If yes, is this in the winter or year round? If no, where do people get there fish from? Would there be some interests in fish culture?

16. **Do people pick medicine or berries in the (resource location) area?** If not, are there other areas nearby which are used?

17. If people still use the (resource location) area for hunting, fishing, trapping, or gathering medicine and berries, then ask **- About how many people use the (resource location) area? Do you think they would welcome developing some of geothermal resource for food production or fish culture?**

Cultural use and sacred sites information:

This section is for information about traditional and cultural use of the area.

18. **Are there areas close by or around (name of resource location) that are culturally significant to the community?**

19. **Have the community done anything to protect cultural sites in the area?**

20. **Are there sites with legends or community stories nearby? Are these sites protected?**

Resource management objectives:

This section captures information about lands management objectives of the community.

21. If the community were to develop direct-use geothermal resources for create more jobs or to increase employment, w**hich of the following would you consider to be lands management objectives?** (please tick all that applies)

☐ Protection of traditional hunting territories;

☐ Ecosystem protection in certain areas;

☐ Known wildlife habitat protection;

☐ Applying Indigenous stewardship principles;

☐ Allocation of trapping right, fishing ground, berry picking area;

☐ Quality of life;

☐ Visual qualities of the area;

☐ Community development ~ increasing people's health and mental wellbeing;

☐ Cultural revitalization;

☐ Developing training opportunities;

☐ Creation of local employment opportunities;

☐ Generating revenue for the community;

☐ More opportunities for people to live off the land;

☐ Incorporating knowledge of the land in development;

☐ Green and carbon neutral developments; and

☐ Others (please specify).

_____

22. **Can developing Direct-use geothermal resource help the community achieve economic development goals?** Would using geothermal resources to grow local produce help?

23. **Are any there cultural significance associated with drilling for heat on certain parts of the territory?** Knowing some of this information would help ensure that things that are culturally significant are protected.

Tourism information:

The following tourist information is available about the (resource location) area. This information is from the web and the 2015 study conducted by KWL.

24. **Is tourism an area of interest for the community?**

25. **Are there known tourist sites in the (resource location) area?**

26. **Are there heritage sites or areas of archaeological interests?**

27. **Are there areas within the vicinity that are 'no-go' for tourism or tourists?**

28. **Are eco-tourists encouraged by the community?**

Other information:

This section for other information the interview participant or community may want to share.

29. **Is there anything else about geothermal direct-use that you would like to share with us or other relevant community information that we should know?**

    _____

    _____

30. Geoscience BC would like to continue with community engagement after this study is complete. **Who would be the contact person for this?**

    Name: _____

    Email address: _____

    Telephone No.: _____

Thank you for your time in participating in this interview. We will be summarizing what we have heard and will forward a copy of this to you.

APPENDIX B:
List of Communities Contacted

APPENDIX B: List of communities contacted

TABLE B1: Summary of communities contacted

	Community	Secondary Data?	Contacted?	Response/Follow up	Nearest Township
1	Acho Dene Koe	yes	no		Fort Liard, NWT
2	Adams Lake Indian Band	yes	yes		Chase, BC
3	Akisqn'uk First Nation	yes	yes		Windermere, BC
4	Bella Coola	no	yes		
5	Blueberry River	yes	yes		Fort St. John, BC
6	Canim Lake Indian Band	partial	no		100 Mile House, BC
7	Carrier Chilcotin Tribal Council	partial	no		Williams Lake, BC
8	City of Terrace	yes	yes		Terrace, BC
9	Clearwater Regional District	no	yes		
10	Coldwater Indian Band	yes	yes		Merritt, BC
11	Cook's Ferry Indian Band	yes	yes		Spences Bridge, BC
12	Da'naxda'xw/Awaetlala First Nation	partial	no		Alert Bay, BC
13	Dene Tha' First Nation	yes	yes		Chateh, AB
14	Doig River First Nation	yes	yes		Rose Prairie, BC
15	Douglas First Nation	yes	yes		Mount Currie, BC
16	Fort Nelson (town of)	no	yes		
17	Fort Nelson First Nation	yes	yes		Fort Nelson, BC
18	Halfway River First Nation	yes	yes		Wonowon, BC
19	Harrison Hot Springs	no	yes		
20	Heiltsuk Nation	partial	no		Bella Bella, BC
21	Heiltsuk Economic Development Corporation	partial	no		Bella Bella, BC
22	In-SHUCK-ch Nation	yes	yes	Please contact Geoscience BC	Deroche, BC
23	Iskut Band	partial	no		Iskut, BC
24	Kitselas First Nation	yes	yes		Terrace, BC
25	Kitsumkalum First Nation	yes	yes		Terrace, BC
26	Ktunaxa Nation Council	yes	yes		Cranbrook, BC
27	Kwantlen First Nation	yes	yes		Fort Langley, BC
28	Lax Kw'alaams Band Council	yes	yes		Lax Kw'alaams, BC
29	Lheidli Band	yes	yes		Prince George, BC
30	Lhoosk'uz Dene Nation	partial	no		Quesnel, BC
31	Lhtako Dene Nation	partial	no		Quesnel, BC
32	Lillooet Tribal Council	yes	yes		Lillooet, BC
33	Little Shuswap Lake Indian Band	partial	no		Chase, BC
34	Lower Kootenay Band	yes	yes		Creston, BC
35	Lower Nicola Indian Band	yes	yes		Merritt, BC
36	Lower Similkameen Indian Band	yes	yes		Keremeos, BC
37	Lytton First Nation	yes	yes		Lytton, BC
38	Metlakatla First Nation	yes	yes		Prince Rupert, BC
39	Mount Currie Band (Lil'wat First Nation)	yes	yes		Mount Currie, BC
40	NanWakolas First Nation	partial	yes		Campbell River, BC
41	Nazko First Nation	partial	yes	Please contact Geoscience BC	Quesnel, BC
42	Neskonlith Indian Band	yes	yes		Chase, BC
43	Nicola Tribal Association	yes	yes		Merritt, BC
44	Nlaka'pamux Nation	yes	yes		Spences Bridge, BC
45	Nooaitch Indian Band	yes	yes		Merritt, BC
46	Nuxalk Nation	partial	no		Bella Coola, BC
47	Okanagan Indian Band	yes	yes		Vernon, BC
48	Okanagan Nation Alliance	yes	no		Westbank, BC
49	Oregon Jack Creek Indian Band	yes	yes		Ashcroft, BC
50	Osoyoos First Nation	no	yes		Oliver, BC
51	Pemberton	no	yes		

APPENDIX B: List of communities contacted

TABLE B1: Summary of communities contacted (continued)

	Community	Secondary Data?	Contacted?	Response/Follow up	Nearest Township
52	Penticton Indian Band	yes	yes		Penticton, BC
53	Prophet River First Nation	yes	yes		Fort Nelson, BC
54	Resort Municipality of Whistler	yes	no		Whistler, BC
55	Samahquam First Nation	yes	yes		Mount Currie, BC
56	Seabird Island Band	yes	yes		Agassiz, BC
57	Secwepemc Nation	yes	yes		Kamloops, BC
58	Shuswap Indian Band	yes	yes		Invermere, BC
59	Simpcw First Nation	yes	yes		Barriere, BC
60	Sinixt Nation (Arrow Lakes)	yes	yes		Winlaw, BC
61	Siska Indian Band	yes	yes		Lytton, BC
62	Skat'in Nations	yes	yes		Pemberton, BC
63	Splats'in First Nation	yes	yes		Enderby, BC
64	Squamish, District of	no	yes		
65	Squamish Nation	yes	yes		North Vancouver, BC
66	St. Mary's Indian Band	yes	yes		Cranbrook, BC
67	St'at'imc Chiefs Council	yes	yes		Lillooet, BC
68	Sto:lo Nation	yes	yes		Chilliwack, BC
69	Sts'ailes First Nation	yes	yes		Agassiz, BC
70	Summerland	partial	no		Summerland, BC
71	Tahltan Indian Band	yes	yes		Telegraph Creek, BC
72	Tahltan Central Council	partial	no	Please contact Geoscience BC	Telegraph Creek, BC
73	Tahltan Nation Development Council	partial	no		Telegraph Creek, BC
74	Tl'etinqox-T'in Government Office (Anaham Band)	partial	no		Alexis Creek, BC
75	Tobacco Plains Indian Band	yes	yes		Grasmere, BC
76	Treaty 8 Lands Office	yes	no		Fort St. John, BC
77	Tsilhqot'in National Government	partial	no		Williams Lake, BC
78	Ulkatcho First Nations	partial	no		Anahim Lake, BC
79	Upper Nicola Indian Band	yes	yes		Merritt, BC
80	Upper Similkameen Indian Band	no	yes		Hedley, BC
81	Valemount	partial	yes	Please contact Geoscience BC	Valemount, BC
82	Westbank First Nation	yes	yes		Westbank, BC
83	West Moberly First Nation	yes	yes		Moberly Lake, BC
	Total	**56**	**63**	**5**	
	partial data collected for communities:	**19**			
	no data collected:	**8**			

APPENDIX B: List of communities contacted

TABLE B2: Summary of community contact information

#	Community Name	Telephone #	Contact name, title, email	Dates Contacted	Follow up notes
1	Adams Lake Indian Band	please contact Geoscience BC for additional info.	please contact Geoscience BC for additional info.	Dec.2, 2015 Dec.3, 2015 Dec.16, 2015 Jan.8, 2016 Jan.18, 2016 Jan.29, 2016 Feb.19, 2016	please contact Geoscience BC for additional info.
2	Akisn'uk First Nation			Dec to Feb	
3	Bella Coola			CJH 22/03/16	
4	Blueberry First Nation			Dec to Feb	
5	Clearwater regional district			CJH 22/03/16	
6	Cold Water First Nation			Dec to Feb	
7	Cooks Ferry Indian Band			Dec to Feb	
8	Dene Tha First Nation			Dec to Feb	
9	Doig River First Nation			Dec to Feb	
10	Douglas First Nation			Dec to Feb	
11	Fort Nelson First Nation			Dec to Feb	
12	Fort Nelson, Town of			CJH 22/03/16	
13	Halfway River First Nation			Dec to Feb	
14	Harrison Hotsprings			CJH 22/03/16	
15	In-Shuck-ch First Nation			Dec to Feb	
16	Kitselas Development			Dec to Feb	
17	Kitselas First Nation			Dec to Feb	
18	Kitsumkalum			Dec to Feb	

TABLE B2: Summary of community contact information (continued)

#	Community Name	Telephone #	Contact name, title, email	Dates Contacted	Follow up notes
19	Ktunaxa Nation Council	please contact Geoscience BC for additional info.	please contact Geoscience BC for additional info.	Dec to Feb	please contact Geoscience BC for additional info.
20	Kwantlen First Nation			Dec to Feb	
21	Lax Kwalaams Band Council			Dec to Feb	
22	Lheidli Indian Band			Dec to Feb	
23	Lillooet Tribal Council			Dec to Feb	
24	Lower Kootenay Indian Band			Dec to Feb	
25	Lower Nicola Indian Band			Dec to Feb	
26	Lower Similikammeen First Nation			Dec to Feb	
27	Lytton First Nation			Dec to Feb	
28	Metlakatla First Nation			Dec to Feb	
29	Mount Currie Lilwat Indian Band			Dec to Feb	
30	NanWakolas First Nation			Dec to Feb	
31	Neskonlith Indian Band			Dec to Feb	
32	Nicola Tribal Association			Dec to Feb	
33	Nlakapamux Nation			Dec to Feb	
34	Nooaitch First Nation			Dec to Feb	
35	Okanagan Indian Band			Dec to Feb	
36	Oregon Jack Creek First Nation			Dec to Feb	
37	Osoyoos First Nation			Dec to Feb	
38	Pemberton			CJH 22/03/16	
39	Penticton Indian Band			Dec to Feb	
40	Prophet River First Nation			Dec to Feb	
41	Samahquam First Nation			Dec to Feb	
42	Seabird First Nation			Dec to Feb	
43	Secwepemc First Nation			Dec to Feb	
44	Simpcw First Nation			Dec to Feb	

TABLE B2: Summary of community contact information (continued)

#	Community Name	Telephone #	Contact name, title, email	Dates Contacted	Follow up notes
45	Sinixt First Nation			Dec to Feb	
46	Siska First Nation			Dec to Feb	
47	Shuswap Indian Band	please contact Geoscience BC for additional info.	please contact Geoscience BC for additional info.	Dec to Feb	please contact Geoscience BC for additional info.
48	Skat'in First Nation			Dec to Feb	
49	Splats'in First Nation			Dec to Feb	
50	Squamish, District of			CJH 22/03/16	
51	Squamish First Nation			Dec to Feb	
52	St'at'imc chiefs council			Dec to Feb	
53	Sto'lo First Nation			Dec to Feb	
54	Sta'ailes First Nation			Dec to Feb	
55	St. Mary's Indian Band			Dec to Feb	
56	Tahltan First Nation			Dec to Feb	
57	Terrace, City of			Dec to Feb	
58	Tobacco Plains First Nation			Dec to Feb	
59	Upper Nicola Indian Band			Dec to Feb	
60	Upper Similkameen Indian Band			Dec to Feb	
61	Valemount			CJH 16/03/16	
62	West Bank First Nation			Dec to Feb	
63	West Moberley First Nation			Dec to Feb	

APPENDIX C:

Expanded Geothermal Development Decision Matrix Section H – Community

APPENDIX C: Expanded Geothermal Development Decision Matrix (GDDM) Section H - Community Issues

Resource Area	Communities Nearby	Indigenous Law and Indigenous Development Areas (stage of BC Treaty Commission negotiation process)	Land claims (ie. Treaty established, Recognized by BCTC, asserted but not recognized)	Km to Resource Area	Community action	Community action (KWL & GeothermEx 2015 data)	Surface Rights (KWL & GeothermEx 2015 data)	Visual considerations	Hot Spring Tourism (Woodsworth and Woodsworth, 2014)	General Tourism (KWL & GeothermEx 2015 data)	Traditional use area
A. Canoe Creek - Valemount	Lheidli	BCTC Stage 5: Lheidli T'enneh First Nation Final Agreement, members voted not to proceed with agreement March 2007, a 2nd vote has not been held.	Canoe Creek is within area of asserted territory by Lheidli's BCTC Final Agreement: http://www.bctreaty.net/nations/soi_maps/LheidlI_Tenneh_Band_SOI_Map.pdf	280 km	Lheidli 2015 Land Use Plan (draft copy), no mention of geothermal, or interest in greenhouse/hatcheries/other developments that could make use of direct-use geothermal.	• Valemount Integrated Community Sustainability Plan adopted in 2013 (http://www.valemount.ca/community-sustainability) sets out 4 main sustainability objectives • Borealis website: "Borealis would like to thank the Community of Valemount for their continued support of the project, and we recently signed a direct heat agreement that entails using the cooled wastewater (approx. 70C) coming from the power plant after power generation for purposes such as sustaining a community greenhouse for food growth and possible public hot springs facilities."	• Simpcw cultural heritage areas for traditional use area, sacred and spiritual areas, areas of historical cultural significance, archaeological sites. (www.simpcw.com)	Logging areas and roads.	Undeveloped hot spring area 32 km southeast of Valemount. In 1973, Mica Dam hydro-electric project flooded Kinbasket Lake, so the springs are only accessible when the lake is at its lowest level (below 720 m). Some years, the lake level never drops enough to expose the springs.	• Simpcw Natural Resource Dept. references "joint ventures with industry in forestry, mining, tourism and utilities." (www.simpcw.com) • Tourism is generally focussed on outdoor and recreational activities. Potential hot springs facilities would complement these activities.	trapping, hunting, food and medicinal plants, fishing activities; Community sacred site, gathering place or event site; archeology sites and other areas of significance; CONSULT THE LISTED COMMUNITIES FOR COMMUNITY-SPECIFIC TRADITIONAL USES OF THE SITE
	Neskonlith	part of Secwepemc Nation, not currently in negotiation with BCTC	Secwepemc traditional territory (not part of BCTC): http://landoftheshuswap.com/map/mapcompressed2ab.htm	210 km	5-year community economic plan 2010-2015: interest in forestry; gardens/markets; re-opening greenhouses; crop production; rustic resort; industrial development; Green business code						
	Secwepemc Nation	BCTC Stage 4: Northern Shuswap Tribal Council has BCTC SOI. Represent 17 First Nation communities. Made up of Northern Shuswap Tribal Council (4 communities: Canim Lake, Canoe & Dog Creek, Soda & Deep Lake, Williams Lake), and Shuswap Nation (9 communities: Adams Lake, Bonaparte, Neskonlith, Shuswap, Simpcw, Skeetchestn, Splatsin, Tk'emlups, Whispering Pines).	Northern Shuswap Tribal Council has BCTC SOI (stage 4 within BCTC treaty process) within 10 km of resource area: http://www.bctreaty.net/nations/documents/SOIMap-AmendedMay2014.pdf	Various, but >165 km; SOI asserted territory area by Northern Shuswap Tribal Council within 10 km.							
	Shuswap	part of Secwepemc Nation, not currently in negotiation with BCTC	Secwepemc traditional territory (not part of BCTC): http://landoftheshuswap.com/map/mapcompressed2ab.htm	315 km	MOU with Borealis						
	Simpcw	part of Secwepemc Nation, not currently in negotiation with BCTC	Secwepemc traditional territory (not part of BCTC): http://landoftheshuswap.com/map/mapcompressed2ab.htm	170 km	MOU with Borealis						
B. Clarke Lake	Acho Dene Koe (NWT)	BCTC Stage 2 (Readiness to negotiate), SOI area exists	SOI area is <95 km north Clarke Lake resource area: ofhttp://www.bctreaty.net/nations/soi_maps/Acho_Dne_Koe_SOI_Map.pdf	165 km	Acho Dene Koe has a Renewable Resource office.	• BC Hydro completed the Site C Clean Energy Project Community Summary for Dene Tha' First Nation. Extent of area is south of proposed geothermal location, however, report includes community summary, BCH consultation summary, land use and resource use summary, aboriginal summary; community was generally apprehensive for new large scale energy development on traditional lands. (See Site C Clean Energy Project, volume 5 Appendix A04 published January 2013) • Fort Nelson Official Community Plan completed in 2006; community goals include expanding the region's economic base, cooperation with agencies in the provision of community services, protect the environment from pollution of the land, water and air and discourage development in areas that are potentially hazardous among others (see For Nelson Official Community Plan).	• First Nation consultative areas include Doig River First Nation, West Moberly First Nation, Prophet River First Nation, Fort Nelson First Nation, Dene Tha' First Nation as per Government of BC First Nations Consultative Areas Database. Consultation also required with Acho Dene Koe as per Geoscience BC recommendation. • Fort Nelson First Nation lands department is responsible for ensuring that the "interests of the Fort Nelson First Nation are represented with regard to all matters of Lands and Natural Resources." (http://www.fortnelsonfirstnation.org/lands--resources.html).	Oil & Gas well pads, logging areas and roads, seismic lines, BC Hydro Peace River hydro dams, BC Hydro Site C development	Prophet River hot springs are about 150 km SW of Fort Nelson, access by helicopter (landing outside of Prophet River Hotsprings Provincial Park), horseback or foot. Soaking is discouraged. Toad River hot springs, 188 km west of Fort Nelson, located in Toad River Hot Springs Provincial Park, offers limited soaking and can only be accesed by helicopter, canoe/kayak and foot.	• Tourism is seasonal since winters are very harsh, cold and snowy, however, still a strong tourism industry in the area. Fort Nelson is on route to Alaska and serves as stop point for road-tripping tourists. Fort Nelson tourism website references several hotels and accommodations. (See Northern Rockies Travel Guide, Fort Nelson tourism website: http://www.tourismnorthernrockies.ca/index.php) • Although there is significant work underway in the natural gas industry, no reports were found to support a large influx of temporary workers in the town of Fort Nelson itself (most workers fly-in, fly-out).	trapping, hunting, food and medicinal plants, fishing activities; Community sacred site, gathering place or event site; archeology sites and other areas of significance; CONSULT THE LISTED COMMUNITIES FOR COMMUNITY-SPECIFIC TRADITIONAL USES OF THE SITE
	Dene Tha' (AB)	Treaty 8 completed agreement (1899) http://www2.gov.bc.ca/gov/content/environment/natural resource-stewardship/consulting-with-first-nations/first-nations-negotiations/first-nations-a-z-listing/treaty-8-first-nations	part of AB's Treaty 8	230 km							
	Doig River	Treaty 8 completed agreement (1899) http://www2.gov.bc.ca/gov/content/environment/natural resource-stewardship/consulting-with-first-nations/first-nations-negotiations/first-nations-a-z-listing/treaty-8-first-nations	Treaty 8 (Includes Doig River, Halfway River, Prophet River, West Moberly and Fort Nelson First Nations). Clarke Lake is within Treaty area.	270 km	Treaty 8 First Nations have a court challenge against development of Site C.						
	Fort Nelson	Treaty 8 completed agreement (1899) http://www2.gov.bc.ca/gov/content/environment/natural resource-stewardship/consulting-with-first-nations/first-nations-negotiations/first-nations-a-z-listing/treaty-8-first-nations	Treaty 8 (Includes Doig River, Halfway River, Prophet River, West Moberly and Fort Nelson First Nations). Clarke Lake is within Treaty area.	<10 km	Fort Nelson worked on a project called "Keepers of the Water" about the development of a Water Management Plan. Treaty 8 First Nations have a court challenge against development of Site C.						
	Prophet River	Treaty 8 completed agreement (1899) http://www2.gov.bc.ca/gov/content/environment/natural resource-stewardship/consulting-with-first-nations/first-nations-negotiations/first-nations-a-z-listing/treaty-8-first-nations	Treaty 8 (Includes Doig River, Halfway River, Prophet River, West Moberly and Fort Nelson First Nations). Clarke Lake is within Treaty area.	70 km	Treaty 8 First Nations have a court challenge against development of Site C.						
	West Moberly	Treaty 8 completed agreement (1899) http://www2.gov.bc.ca/gov/content/environment/natural resource-stewardship/consulting-with-first-nations/first-nations-negotiations/first-nations-a-z-listing/treaty-8-first-nations	Treaty 8 (Includes Doig River, Halfway River, Prophet River, West Moberly and Fort Nelson First Nations). Clarke Lake is within Treaty area.	330 km	Treaty 8 First Nations have a court challenge against development of Site C.						

APPENDIX C: Expanded Geothermal Development Decision Matrix (GDDM) Section H - Community Issues

Resource Area	Communities Nearby	Indigenous Law and Indigenous Development Areas (stage of BC Treaty Commission negotiation process)	Land claims (ie. Treaty established, Recognized by BCTC, asserted but not recognized)	Km to Resource Area	Community action	Community action (KWL & GeothermEx 2015 data)	Surface Rights (KWL & GeothermEx 2015 data)	Visual considerations	Hot Spring Tourism (Woodsworth and Woodsworth, 2014)	General Tourism (KWL & GeothermEx 2015 data)	Traditional use area
C. Clearwater	Canim Lake	BCTC Stage 4: Northern Shuswap Tribal Council has BCTC SOI. Represent 17 First Nation communities. Made up of Northern Shuswap Tribal Council (4 communities: Canim Lake, Canoe & Dog Creek, Soda & Deep Lake, Williams Lake), and Shuswap Nation (9 communities: Adams Lake, Bonaparte, Neskonlith, Shuswap, Simpcw, Skeetchestn, Splatsin, Tk'emlups, Whispering Pines).	Northern Shuswap Tribal Council has BCTC SOI (stage 4 within BCTC treaty process) within 10 km of resource area: http://www.bctreaty.net/nations/documents/SOIMap-AmendedMay2014.pdf	70 km		• Clearwater, BC is carbon neutral BC Climate Action Community 2012. (http://www.districtofclearwater.com/news/407-clearwater-is-a-carbon-neutral-bc-climate-action-community-2012).		logging, volcanic area, Provincial Park	no hot spring tourism nearby, closest is Valemount/Jasper, Banff, and the Kootenays.	• Tourism is a large industry along with the major forestry industry in Clearwater. Tourism includes outdoor recreational activities, advertised as "more than just a stop over location" on Clearwater's tourism website. (http://www.districtofclearwater.com/visitors/tourism)	trapping, hunting, food and medicinal plants, fishing activitie; Community sacred site, gathering place or event site; archeology sites and other areas of significance; CONSULT THE LISTED COMMUNITIES FOR COMMUNITY-SPECIFIC TRADITIONAL USES OF THE SITE
	Neskonlith	part of Secwepemc Nation, not currently in negotiation with BCTC	Secwepemc traditional territory (not part of BCTC): http://landoftheshuswap.com/map/mapcompressed2ab.htm	125 km	5-year community economic plan 2010-2015: interest in forestry; gardens/markets; re-opening greenhouses; crop production; rustic resort; industrial development; Green business code	• Clearwater, BC official community plan is currently under public consultation. Vision includes a carbon-neutral community achieved through the use of innovative energy alternatives, power productions and new construction. (Clearwater Official Community Plan).					
	Simpcw	part of Secwepemc Nation, not currently in negotiation with BCTC	Secwepemc traditional territory (not part of BCTC): http://landoftheshuswap.com/map/mapcompressed2ab.htm	70 km							
D. Iskut	Iskut Band	not currently in negotiation with BCTC; government representatives are working to build relationships with the Tahltan Band Council and Iskut First Nations (its members) outside the BC treaty process through the Tahltan Central Council.	asserted territory: Tahltan territory is located in northern British Columbia, Canada and encompasses about 93,500 km2. The north/western border runs parallel to the Alaskan/Canadian border, and includes part of the Yukon Territory. The south/eastern border includes the upper Nass tributaries and western half of the Stikine plateau, including the sacred headwaters of the Stikine, Nass and Skeena rivers.	90 km	opposition against coal mining development (http://iskut.org/press-coverage/tahltan-nation-welcomes-halt-klappan-coal-permitting/)	• Iskut Band Council (http://iskut.org/) does not provide any specific community/environmental planning agendas		Remote area. Iskut River Hot Springs Provincial Park.	Iskut Hot Springs are located within Iskut River Hot Springs Provincial Park, on the west bank of the Iskut River, a large tributary of the Stikine. The springs are about 6 km north of the bridge (private and gated) across the Iskut River near the mouth of More Creek, west of Highway 37 near Bob Quinn. The 6 km walk is a very tough hike, or you can fly in by helicopter. Several other hot springs in the area are just as tough or tougher to reach: Mess Creek, Mess Lake, Sezill (Taweh Creek), Elwyn Creek, and Choquette Springs.	• Bob Quinn Lake Airport is near proposed project location. • Schoquette Hot Springs is near Stikine, BC. • Proposed project location is remote; no significant infrastructure in within extents of project, although Bob Quinn Lake is a recreational outdoors park.	trapping, hunting, food and medicinal plants, fishing activities; Community sacred site, gathering place or event site; archeology sites and other areas of significance; CONSULT THE LISTED COMMUNITIES FOR COMMUNITY-SPECIFIC TRADITIONAL USES OF THE SITE
	Tahltan Central Council	not currently in negotiation with BCTC; government representatives are working to build relationships with the Tahltan Band Council and Iskut First Nations (its members) outside the BC treaty process through the Tahltan Central Council.	asserted territory: Tahltan territory is located in northern British Columbia, Canada and encompasses about 93,500 km2. The north/western border runs parallel to the Alaskan/Canadian border, and includes part of the Yukon Territory. The south/eastern border includes the upper Nass tributaries and western half of the Stikine plateau, including the sacred headwaters of the Stikine, Nass and Skeena rivers.	105 km	opposition against coal mining development (http://iskut.org/press-coverage/tahltan-nation-welcomes-halt-klappan-coal-permitting/)	• Tahltan Nation plan is in development (started 2011); broad issues that have been identified include better community infrastructure (particularly Bob Quinn and Dease Lake), managing social-culture growth. (http://www.tahltan.org/news/tahltan-nation-plan-community-vision-our-future)					
	Tahltan Indian Band	not currently in negotiation with BCTC; government representatives are working to build relationships with the Tahltan Band Council and Iskut First Nations (its members) outside the BC treaty process through the Tahltan Central Council.	asserted territory: Tahltan territory is located in northern British Columbia, Canada and encompasses about 93,500 km2. The north/western border runs parallel to the Alaskan/Canadian border, and includes part of the Yukon Territory. The south/eastern border includes the upper Nass tributaries and western half of the Stikine plateau, including the sacred headwaters of the Stikine, Nass and Skeena rivers.	105 km	opposition against coal mining development (http://iskut.org/press-coverage/tahltan-nation-welcomes-halt-klappan-coal-permitting/). TNDC and Tahltan Nation invest in Imperial Metals' Red Chris mine (http://www.tndc.ca/news-releases/2015/tndc-and-the-tahltan-nation-invest-in-imperial-metals)	• 2005 community action stopped Shell Canada test well activities					
	Tahltan Nation Development Council	the business arm of Tahltan Nation.		105 km	TNDC and Tahltan Nation invest in Imperial Metals' Red Chris mine (http://www.tndc.ca/news-releases/2015/tndc-and-the-tahltan-nation-invest-in-imperial-metals)	• Tahltan Nation Development Council is business council owned by the people of Tahltan Iskut bands and ensures First Nation consultation, involvement in economic ventures within Tahltan territory. (http://www.tahltan.org/nation/economy/economic-development)					

Resource Area	Communities Nearby	Indigenous Law and Indigenous Development Areas (stage of BC Treaty Commission negotiation process)	Land claims (ie. Treaty established, Recognized by BCTC, asserted but not recognized)	Km to Resource Area	Community action	Community action (KWL & GeothermEx 2015 data)	Surface Rights (KWL & GeothermEx 2015 data)	Visual considerations	Hot Spring Tourism (Woodsworth and Woodsworth, 2014)	General Tourism (KWL & GeothermEx 2015 data)	Traditional use area
E. Jedney Area	Blueberry River	Treaty 8 completed agreement (1899) http://www2.gov.bc.ca/gov/content/environment/natural resource-stewardship/consulting-with-first-nations/first-nations-negotiations/first-nations-a-z-listing/treaty-8-first-nations	Treaty 8 (Includes Blueberry River, Doig River, Halfway River, Prophet River, West Moberly and Fort Nelson First Nations). Jedney area is within Treaty area.	95 km	Treaty 8 First Nations have a court challenge against development of Site C.	• Treaty 8 First Nations demonstrate against BC Hydro Dam in Fort St. John. • No existing land use plan found related to the proposed plant location.		Spectra Energy Jedney Gas Plant; logging areas and roads	no hot spring tourism in the nearby area (closest are near Fort Nelson and Jasper/Valemount).	• Due to remote location of proposed plant, no significant tourism activity is noted in the area. • Sikanni Chief Provincial Park is close to proposed plant location. • Proposed plant location is off the Alaska Highway; potential to create new recreational access.	trapping, hunting, food and medicinal plants, fishing activities; Community sacred site, gathering place or event site; archeology sites and other areas of significance; CONSULT THE LISTED COMMUNITIES FOR COMMUNITY-SPECIFIC TRADITIONAL USES OF THE SITE
	Dene Tha' (AB)	Treaty 8 completed agreement (1899) http://www2.gov.bc.ca/gov/content/environment/natural resource-stewardship/consulting-with-first-nations/first-nations-negotiations/first-nations-a-z-listing/treaty-8-first-nations	part of AB's Treaty 8	265 km	Treaty 8 First Nations have a court challenge against development of Site C.						
	Doig River	Treaty 8 completed agreement (1899) http://www2.gov.bc.ca/gov/content/environment/natural resource-stewardship/consulting-with-first-nations/first-nations-negotiations/first-nations-a-z-listing/treaty-8-first-nations	Treaty 8 (Includes Blueberry River, Doig River, Halfway River, Prophet River, West Moberly and Fort Nelson First Nations). Jedney area is within Treaty area.	130 km	Treaty 8 First Nations have a court challenge against development of Site C.						
	Halfway River	Treaty 8 completed agreement (1899) http://www2.gov.bc.ca/gov/content/environment/natural resource-stewardship/consulting-with-first-nations/first-nations-negotiations/first-nations-a-z-listing/treaty-8-first-nations	Treaty 8 (Includes Blueberry River, Doig River, Halfway River, Prophet River, West Moberly and Fort Nelson First Nations). Jedney area is within Treaty area.	90 km	Treaty 8 First Nations have a court challenge against development of Site C.						
	Prophet River	Treaty 8 completed agreement (1899) http://www2.gov.bc.ca/gov/content/environment/natural resource-stewardship/consulting-with-first-nations/first-nations-negotiations/first-nations-a-z-listing/treaty-8-first-nations	Treaty 8 (Includes Blueberry River, Doig River, Halfway River, Prophet River, West Moberly and Fort Nelson First Nations). Jedney area is within Treaty area.	95 km	Treaty 8 First Nations have a court challenge against development of Site C.						
	West Moberly	Treaty 8 completed agreement (1899) http://www2.gov.bc.ca/gov/content/environment/natural resource-stewardship/consulting-with-first-nations/first-nations-negotiations/first-nations-a-z-listing/treaty-8-first-nations	Treaty 8 (Includes Blueberry River, Doig River, Halfway River, Prophet River, West Moberly and Fort Nelson First Nations). Jedney area is within Treaty area.	165 km	Treaty 8 First Nations have a court challenge against development of Site C.						
F. King Island	Heiltsuk Economic Development Corporation				Community businesses mostly services (http://heiltsukdevco.com/hedc-business/companies-services-products).	• Nuxalk Nation Smayusta summary of action is documented against logging, mining, fish farms from 1995 to 2003. (http://www.nuxalk.net/) • Demonstration against Enbridge at Bella Bella in 2012 (http://www.nuxalk.net/html/enbridge_rejected.html). • Nuxalk activists and supporters blockaded logging roads on King Island to protect the Great Bear Rainforest in 1995 (http://www.firstnations.eu/forestry/nuxalk.htm) • Other community action related to fish farming, logging and mining documented up to 2003 (http://www.firstnations.eu/forestry/nuxalk.htm) • Bella Coola Residents protested ferry cuts in 2014. (http://www.coastmountainnews.com/news/252922161.html) • Bella Coola Food Action Plan developed with Vancouver Coastal Health in 2006 with goal for community food security and access for all healthy sustainable food system (see Bella Coola Food Action Plan).		Extremely remote location, would require barge access.	Talheo Hot Springs are on the southwest shore of South Bentinck Arm, southwest of Bensins Island - accessible by boat or floatplane. Used by the Nuxalk people for ceremonial purposes. If the site is occupied, ask permission before intruding, or come back at a different time. Nascall Hot Springs are near the resource area but as of 2014, the closed springs resort and surrounding land were for sale. Plans for a 70MW hydro-electric project on the nearby Nascall River have been shelved, at least temporarily. Eucott Bay hot springs also nearby, best reached by boat or floatplane, have been used by the Heiltsuk people for thousands of years.	• Bella Coola is a vacation destination for outdoor recreation including camping, hiking, kayaking. It is advertised as the "Gateway to the Great Bear Rainforest." (http://bellacoola.ca/). • No significant tourism industry found on King Island.	trapping, hunting, food and medicinal plants, fishing activities; Community sacred site, gathering place or event site; archeology sites and other areas of significance; CONSULT THE LISTED COMMUNITIES FOR COMMUNITY-SPECIFIC TRADITIONAL USES OF THE SITE
	Heiltsuk Nation	BCTC Stage 4: Heiltsuk Nation Framework Agreement signed April 2, 1997 (http://www.bctreaty.net/nations/agreements/heiltsuk_framewrk.pdf)	within Heiltsuk Nation SOI map: (http://www.bctreaty.net/nations/soi_maps/Heiltsuk_Nation_SOI_Map.pdf).	70 km	Stand against Enbridge (http://www.heiltsuknation.ca/wp-content/uploads/2016/01/Heiltsuk-Enbridge-Declaration.pdf). Agreement reached to protect Great Bear Rain Forest (http://www.heiltsuknation.ca/final-agreement-reached-to-protect-b-c-s-great-bear-rain-forest/).						
	Nuxalk Nation	not currently negotiating with BCTC (http://nuxalk.net/html/treaty.htm)	within Nuxalk asserted territory: http://nuxalk.net/images/map-2b.jpg	40 km	Hot Spring used for healing are visited by local First Nation: http://nuxalk.net/html/hot_springs.htm. Protests against Enbridge in 2012 (http://nuxalk.net/html/enbridge_rejected.html, http://nuxalk.net/media/enbridge.pdf). Protests against fish farming in early 2000s (http://nuxalk.net/html/fish_farms.htm; http://nuxalk.net/media/pr-2003-fish-farms.pdf).						

APPENDIX C: Expanded Geothermal Development Decision Matrix (GDDM) Section H - Community Issues

Resource Area	Communities Nearby	Indigenous Law and Indigenous Development Areas (stage of BC Treaty Commission negotiation process)	Land claims (ie. Treaty established, Recognized by BCTC, asserted but not recognized)	Km to Resource Area	Community action	Community action (KWL & GeothermEx 2015 data)	Surface Rights (KWL & GeothermEx 2015 data)	Visual considerations	Hot Spring Tourism (Woodsworth and Woodsworth, 2014)	General Tourism (KWL & GeothermEx 2015 data)	Traditional use area
G. Kootenay	Adams Lake	part of Secwepemc Nation, not currently in negotiation with BCTC	Secwepemc traditional territory (not part of BCTC): http://landoftheshuswap.com/map/mapcompressed2ab.htm	235 km							
	Akisqnuk	BCTC Stage 4: Ktunaxa Nation Council	within Ktunaxa Nation Council (includes Akisqnuk, Tobacco Plains, St. Mary's, Lower Kootenay) SOI: http://www.bctreaty.net/nations/soi_maps/Ktunaxa_Kinbasket_SOI_Map.pdf	105 km							
	Lower Kootenay	BCTC Stage 4: Ktunaxa Nation Council	within Ktunaxa Nation Council (includes Akisqnuk, Tobacco Plains, St. Mary's, Lower Kootenay) SOI: http://www.bctreaty.net/nations/soi_maps/Ktunaxa_Kinbasket_SOI_Map.pdf	80 km	LKB Economic Sector Strategy 2013-2017: http://lowerkootenay.com/download/46/; interest in horticulture and greenhouse opportunities, natural resources consulting opportunities	• Lower Kootenay Band purchasing Ainsworth hot spring near Kaslo, BC. • Lower Kootenay Band (part of Ktunaxa Nation) is responsible for the stewardship of the lands and resources within the stewardship area that includes the proposed plant location. (http://lowerkootenay.com/departments/lands-and-resources/). • The Lower Kootenay Band's vision for economic development incudes a large majority of business interests currently in forestry, agriculture, energy and tourism; the band is "always open to discuss potential business partnerships or economic development on our community lands." (http://lowerkootenay.com/departments/economic-development/) • Ainsworth Town-site Local Area Plan examines the introduction of commercial services to promote full time residents		BC Hydro dams, logging areas and roads	Ainsworth Hot Springs is a commercial resort open all year round, 115 km southeast of Nakusp. Crawford Creek Warm Springs (30C) is a small unattractive pool accessed by a short, steep hike - the pools don't seem to get much use. Several springs also along the Columbia River valley, accessible south of Golden, BC: Fairmont and Radium commercial hot spring resorts, and Red Rock, Lussier, Ram Creek, Wild Horse, Buhl Creek and Dewar Creek hot springs.	.	trapping, hunting, food and medicinal plants, fishing activities; Community sacred site, gathering place or event site; archeology sites and other areas of significance; CONSULT THE LISTED COMMUNITIES FOR COMMUNITY-SPECIFIC TRADITIONAL USES OF THE SITE
	Lower Similkameen	part of Okanagan Nation Alliance, not currently in negotiation with BCTC	Not currently in negotiation with BCTC, but asserts claim to: http://www.syilx.org/wordpress/wp-content/themes/ONA/images/ON_Territory.pdf	220 km						• Existing extensive outdoor recreation tourism industry including camping, hiking, skiing, hot springs.	
	Neskonlith	part of Secwepemc Nation, not currently in negotiation with BCTC	Secwepemc traditional territory (not part of BCTC): http://landoftheshuswap.com/map/mapcompressed2ab.htm	235 km	5-year community economic plan 2010-2015: interest in forestry; gardens/markets; re-opening greenhouses; crop production; rustic resort; industrial development; Green business code						
	Okanagan	part of Okanagan Nation Alliance, not currently in negotiation with BCTC	Not currently in negotiation with BCTC, but asserts claim to: http://www.syilx.org/wordpress/wp-content/themes/ONA/images/ON_Territory.pdf	185 km							
	Penticton	part of Okanagan Nation Alliance, not currently in negotiation with BCTC	Not currently in negotiation with BCTC, but asserts claim to: http://www.syilx.org/wordpress/wp-content/themes/ONA/images/ON_Territory.pdf	200 km							
	Secwepemc Nation	BCTC Stage 4: Northern Shuswap Tribal Council has BCTC SOI. Represent 17 First Nation communities. Made up of Northern Shuswap Tribal Council (4 communities: Canim Lake, Canoe & Dog Creek, Soda & Deep Lake, Williams Lake), and Shuswap Nation (9 communities: Adams Lake, Bonaparte, Neskonlith, Shuswap, Simpcw, Skeetchestn, Splatsin, Tk'emlups, Whispering Pines).	Northern Shuswap Tribal Council has BCTC SOI (stage 4 within BCTC treaty process) about 300 km from resource area: http://www.bctreaty.net/nations/documents/SOI Map-AmendedMay2014.pdf. Secwepemc traditional territory (not part of BCTC) is about 25 km north of resource area: http://landoftheshuswap.com/map/mapcompressed2ab.htm	various, but >90 km							
	Shuswap	part of Secwepemc Nation, not currently in negotiation with BCTC	Secwepemc traditional territory (not part of BCTC) is about 25 km north of resource area: http://landoftheshuswap.com/map/mapcompressed2ab.htm	110 km							
	St. Mary's	BCTC Stage 4: Ktunaxa Nation Council	within Ktunaxa Nation Council (includes Akisqnuk, Tobacco Plains, St. Mary's, Lower Kootenay) SOI: http://www.bctreaty.net/nations/soi_maps/Ktunaxa_Kinbasket_SOI_Map.pdf	90 km							
	Tobacco Plains	BCTC Stage 4: Ktunaxa Nation Council	within Ktunaxa Nation Council (includes Akisqnuk, Tobacco Plains, St. Mary's, Lower Kootenay) SOI: http://www.bctreaty.net/nations/soi_maps/Ktunaxa_Kinbasket_SOI_Map.pdf	155 km							
	Upper Nicola	part of Okanagan Nation Alliance, not currently in negotiation with BCTC	Not currently in negotiation with BCTC, but asserts claim to: http://www.syilx.org/wordpress/wp-content/themes/ONA/images/ON_Territory.pdf	245 km							

Resource Area	Communities Nearby	Indigenous Law and Indigenous Development Areas (stage of BC Treaty Commission negotiation process)	Land claims (ie. Treaty established, Recognized by BCTC, asserted but not recognized)	Km to Resource Area	Community action	Community action (KWL & GeothermEx 2015 data)	Surface Rights (KWL & GeothermEx 2015 data)	Visual considerations	Hot Spring Tourism (Woodsworth and Woodsworth, 2014)	General Tourism (KWL & GeothermEx 2015 data)	Traditional use area
H. Lakelse Lake	Kitselas	BCTC Stage 5: Kitselas Agreement in Principle was signed Aug 4, 2015 and the parties are in Final Agreement negotiations. (Kitselas is part of Tsimshian First Nations)	within Tsimshian First Nations SOI (map not available on BCTC site, but outline is in shapefile)	20 km	Consortium partner of Borealis for geothermal exploration permit. Detailed land use plan, with interest in fish processing, greenhouses http://www.kitselas.com/images/uploads/docs/Kitselas_Land_Use_Plan.pdf			Accessible by paved Highway 37. Lakelse Lake wetland area and Provincial Park are nearby.	Lakelse (Mount Layton) Hot Springs is a commercial resort, now closed (dispute with health authorities about whether pools need to be chlorinated or not).	• Proposed transmission line routing follows boundary of Lakelse Lake Provincial Park. Transmission line routing is also close to existing Hai Lake - Mount Herman Provincial Park and Lakelse Lake Wetlands Provincial Park. Lakelse Lake Park offers hiking, swimming, fishing, biking, winter activities, and camping (http://www.env.gov.bc.ca/bcparks/explore/parkpgs/lakelse_lk/) • Terrace, BC has significant eco tourism industry that is punctuated by Lakelse Lake Provincial Park (http://www.visitterrace.com/stage.php/places/cabins-campgrounds-rvparks/lakelse-lake-prov-park)	trapping, hunting, food and medicinal plants, fishing activities; Community sacred site, gathering place or event site; archeology sites and other areas of significance; CONSULT THE LISTED COMMUNITIES FOR COMMUNITY-SPECIFIC TRADITIONAL USES OF THE SITE
	Kitsumkalum	BCTC Stage 5: Kitsumkalum Agreement in Principle was signed Aug 4, 2015 and the parties are in Final Agreement negotiations. (Kitsumkalum is part of Tsimshian First Nations)	within Tsimshian First Nations SOI (map not available on BCTC site, but outline is in shapefile)	25 km							
	Lax Kw'alaams	BCTC Stage 2: Allied Tribes of Lax Kw'alaams	within Allied Tribes of Lax Kw'alaams SOI (map not available on BCTC site, but outline is in shapefile)	125 km	Fisheries, Fish Processing, Forestry, Greenhouse Project, http://laxkwalaams.ca/band-owned-business/; http://laxkwalaams.ca/growing-healthy-lifestyles-in-lax-kwalaams/						
	Metlakatla	BCTC Stage 4: part of Tsimshian First Nations, but have not yet signed Agreement in Principle along with Kitselas and Kisumkalum.	within Tsimshian First Nations SOI (map not available on BCTC site, but outline is in shapefile)	125 km							
	Terrace			20 km		• Terrace Official Community Plan includes GHG reduction target of 80% below 2007 level by 2050. Economic development includes Northwest Transmission Line, Rio-Tinto Alcan smelter modernization and major mining proposals. Objective 6 of Official Community Plan to work towards community energy self-sufficiency includes evaluation of alternative heat generation resources such as geothermal and waste heat recovery. Borealis has made presentations to the Terrace City Council.					

APPENDIX C: Expanded Geothermal Development Decision Matrix (GDDM) Section H - Community Issues

Resource Area	Communities Nearby	Indigenous Law and Indigenous Development Areas (stage of BC Treaty Commission negotiation process)	Land claims (ie. Treaty established, Recognized by BCTC, asserted but not recognized)	Km to Resource Area	Community action	Community action (KWL & GeothermEx 2015 data)	Surface Rights (KWL & GeothermEx 2015 data)	Visual considerations	Hot Spring Tourism (Woodsworth and Woodsworth, 2014)	General Tourism (KWL & GeothermEx 2015 data)	Traditional use area
I. Lower Arrow Lake	Adams Lake	part of Secwepemc Nation, not currently in negotiation with BCTC	Secwepemc traditional territory (not part of BCTC): http://landoftheshuswap.com/map/mapcompressed2ab.htm	165 km		• Perry Ridge Wilderness Initiative - united campaign with Perry Ridge Water Users Association to protect Perry Ridge in the Slocan Valley (http://www.perryridge.org/about-perryridge/overview/) • 2010 - Injunction against Sinixt protest for Perry Ridge overturned by Vancouver court • 2013 Sinixt Nation receives notice of trespass at Perry Ridge • Challenge to Pass Creek logging	• Many of the consultative areas have community or land use plans however none are found to be near the proposed plant location. • Sinixt Nation (Arrow Lakes) is most relevant to plant location (http://sinixtnation.org/content/sinixt-territory). Requirement for "corporations, provincial and federal governments and their agents and employees consult with the Sinixt Nation is regards to development and business operations and land use and resource extraction with the territory."	Logging areas and roads.	Octopus Creek Hot Springs is 57 km from Nakusp has very small flow, poor soaking and is a tough hike in. Taylor Warm Springs (25C) is about 40 km from Nakusp and is probably the least visited spring in the southern half of BC. It has a warm, low flow, is a bushy area and uninteresting.	• Lower Arrow Lakes-Needle Ferry, outdoor recreation area. Most activities are centralized near Fauquier, BC. (http://www.kootenayseh.com/nakusp/fauquier.html)	trapping, hunting, food and medicinal plants, fishing activities; Community sacred site, gathering place or event site; archeology sites and other areas of significance; CONSULT THE LISTED COMMUNITIES FOR COMMUNITY-SPECIFIC TRADITIONAL USES OF THE SITE
	Akisqnuk	BCTC Stage 4: Ktunaxa Nation Council	within Ktunaxa Nation Council (includes Akisqnuk, Tobacco Plains, St. Mary's, Lower Kootenay) SOI: http://www.bctreaty.net/nations/soi_maps/Ktunaxa_Kinbasket_SOI_Map.pdf	170 km							
	Lower Kootenay	BCTC Stage 4: Ktunaxa Nation Council	within Ktunaxa Nation Council (includes Akisqnuk, Tobacco Plains, St. Mary's, Lower Kootenay) SOI: http://www.bctreaty.net/nations/soi_maps/Ktunaxa_Kinbasket_SOI_Map.pdf	135 km	LKB Economic Sector Strategy 2013-2017: http://lowerkootenay.com/download/46/; interest in horticulture and greenhouse opportunities, natural resources consulting opportunities						
	Lower Similkameen	part of Okanagan Nation Alliance, not currently in negotiation with BCTC	Not currently in negotiation with BCTC, but asserts claim to: http://www.syilx.org/wordpress/wp-content/themes/ONA/images/ON_Territory.pdf	145 km							
	Neskonlith	part of Secwepemc Nation, not currently in negotiation with BCTC	Secwepemc traditional territory (not part of BCTC): http://landoftheshuswap.com/map/mapcompressed2ab.htm	165 km	Neskonlith 5-year community economic plan 2010-2015: interest in forestry; gardens/markets; re-opening greenhouses; crop production; rustic resort; industrial development; Green business code						
	Okanagan	part of Okanagan Nation Alliance, not currently in negotiation with BCTC	Not currently in negotiation with BCTC, but asserts claim to: http://www.syilx.org/wordpress/wp-content/themes/ONA/images/ON_Territory.pdf	110 km							
	Penticton	part of Okanagan Nation Alliance, not currently in negotiation with BCTC	Not currently in negotiation with BCTC, but asserts claim to: http://www.syilx.org/wordpress/wp-content/themes/ONA/images/ON_Territory.pdf	120 km							
	Secwepemc Nation	BCTC Stage 4: Northern Shuswap Tribal Council has BCTC SOI. Represent 17 First Nation communities. Made up of Northern Shuswap Tribal Council (4 communities: Canim Lake, Canoe & Dog Creek, Soda & Deep Lake, Williams Lake), and Shuswap Nation (9 communities: Adams Lake, Bonaparte, Neskonlith, Shuswap, Simpcw, Skeetchestn, Splats'in, Tk'emlups, Whispering Pines).	Northern Shuswap Tribal Council has BCTC SOI (stage 4 within BCTC treaty process) about 300 km from resource area: http://www.bctreaty.net/nations/documents/SOIMap-AmendedMay2014.pdf	various, but >115 km							
	Shuswap	part of Secwepemc Nation, not currently in negotiation with BCTC	Secwepemc traditional territory (not part of BCTC) is about 25 km north of resource area: http://landoftheshuswap.com/map/mapcompressed2ab.htm	170 km							
	Sinixt Nation	not currently in negotiation with BCTC; not currently recognized by BC or Canadian government as a First Nation	resource area is within Sinixt asserted territory (not part of BCTC): http://sinixtnation.org/content/sinixt-territory	No reserve area							
	Splats'in	part of Secwepemc Nation, not currently in negotiation with BCTC	Secwepemc traditional territory (not part of BCTC): http://landoftheshuswap.com/map/mapcompressed2ab.htm	115 km							
	St. Mary's	BCTC Stage 4: Ktunaxa Nation Council	within Ktunaxa Nation Council (includes Akisqnuk, Tobacco Plains, St. Mary's, Lower Kootenay) SOI: http://www.bctreaty.net/nations/soi_maps/Ktunaxa_Kinbasket_SOI_Map.pdf	170 km							
	Tobacco Plains	BCTC Stage 4: Ktunaxa Nation Council	within Ktunaxa Nation Council (includes Akisqnuk, Tobacco Plains, St. Mary's, Lower Kootenay) SOI: http://www.bctreaty.net/nations/soi_maps/Ktunaxa_Kinbasket_SOI_Map.pdf	230 km							
	Upper Nicola	part of Okanagan Nation Alliance, and Nicola Tribal Association, not currently in negotiation with BCTC	Not currently in negotiation with BCTC, but asserts claim to: http://www.syilx.org/wordpress/wp-content/themes/ONA/images/ON_Territory.pdf	165 km							
	Westbank	BCTC Stage 4: Westbank Framework agreement: http://www.bctreaty.net/nations/agreements/westbank_frmwrk.pdf	within Westbank SOI area: http://www.bctreaty.net/nations/soi_maps/Westbank_SOI_Map.pdf	110 km							

APPENDIX C: Expanded Geothermal Development Decision Matrix (GDDM) Section H - Community Issues

Resource Area	Communities Nearby	Indigenous Law and Indigenous Development Areas (stage of BC Treaty Commission negotiation process)	Land claims (ie. Treaty established, Recognized by BCTC, asserted but not recognized)	Km to Resource Area	Community action	Community action (KWL & GeothermEx 2015 data)	Surface Rights (KWL & GeothermEx 2015 data)	Visual considerations	Hot Spring Tourism (Woodsworth and Woodsworth, 2014)	General Tourism (KWL & GeothermEx 2015 data)	Traditional use area
J. Meager/Pebble Creek	Lillooet Tribal Council, aka or part of St'at'imc Chiefs Council ?	not currently in negotiation with BCTC	within asserted territory by St'at'imc Chiefs Council: http://www.statimc.net/	various but >65 km		• 2010 threatened community action over suspected infrastructure trespasses. • 2011 St'at'imc Hydro Agreement covers all past, present and future impacts, grievances and claims of the St'at'imc related to the planning, placement, construction, and ongoing operation of existing BC Hydro facilities within territory. • 2006 St'at'imc action (temporary closure of Hwy 1, camp "held the line for 5 years between Lillooet and Pemberton" against plans for mega ski resort between Pemberton and Lillooet).	• Significant protected habitat with St'at'imc Land and Resources Authority - SLRA (www.statimc.net) but doesn't cover extent of Meager Creek in St'at'imc Territory	Meager hot springs development by Mike Sato. Nearby hydro-electric development by Innergex. Logging areas and roads.	Excellent first-rate hot springs (non-commercial), located northwest of Pemberton. 2010 Capricorn Creek slide obliterated access, now requires a tough 11-km hike in.	• Significant tourism area close to the sea to sky corridor. Active hot springs in the area and lots of recreational hiking/activities. Currently there is no access to Meager Hot Springs due to road wash-out (2010). Road re-build for geothermal may increase tourism in the area. St'at'imc development plant does not specifically target tourism. Lillooet and area economic opportunity assessment names tourism as potential opportunity.	trapping, hunting, food and medicinal plants, fishing activities; Community sacred site, gathering place or event site; archeology sites and other areas of significance; CONSULT THE LISTED COMMUNITIES FOR COMMUNITY-SPECIFIC TRADITIONAL USES OF THE SITE
	Mount Currie	part of St'at'imc Chiefs Council, not currently in negotiation with BCTC	within asserted territory by St'at'imc Chiefs Council: http://www.statimc.net/	65 km							
	St'at'imc Chiefs Council	not currently in negotiation with BCTC	within asserted territory by St'at'imc Chiefs Council: http://www.statimc.net/	various but >65 km							
K. Mt. Cayley	Whistler			25 km		• Whistler (closest community) Community Plan boundaries include only Resort Municipality development areas; however, plan includes guidelines for water and energy efficiency to reduce GHG emissions (Whistler Official Community Plan). • Squamish and Lil'wat First Nation want Whistler Official Community Plan overturned because it does not provided Lil'wat any opportunity to participate in future economic growth • In 2001, Squamish Nation developed the sacred land use plan that identifies four types of land use zones: forest stewardship zones, sensitive areas, restoration areas and wild spirit places. (http://www.squamish.net/about-us/our-land/xay-temixw-sacred-land-land-use-plan/) No actual maps or PDFs of the plan are provided. • Squamish Community Development Plan provides priority development areas along with method of funding. (httpsquamishfamilymeeting.com) • Government of BC provided funding in 2013 to assess renewable energy potential in the Traditional Territory of Squamish Nation. (http://www.newsroom.gov.bc.ca/2013/03/cleanenergy-opportunities-for-11-first-nations-communities.html).		Logging areas and roads.	no hot spring tourism in the nearby area (closest are near Meager Creek and Sloquet)	• Squamish Nation traditional territory encompasses significant existing tourism areas. The majority of tourism opportunities are related to outdoor recreation and includes sacred sites such as the popular hiking area of Stawamus Chief. The Squamish Nation Land use plan emphasizes the "need for more training and meaningful employment opportunities for Squamish Nation Members, especially from forestry and Tourism" (http://www.squamish.net/about-us/our-land/xay-temixw-sacred-land-land-use-plan/)	trapping, hunting, food and medicinal plants, fishing activities; Community sacred site, gathering place or event site; archeology sites and other areas of significance; CONSULT THE LISTED COMMUNITIES FOR COMMUNITY-SPECIFIC TRADITIONAL USES OF THE SITE
	Squamish Nation	BCTC Stage 3: Squamish Nation	within Squamish Nation SOI (http://www.bctreaty.net/nations/soi_maps/Squamish_01_SOI_Map.pdf).	90 km							

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Resource Area	Communities Nearby	Indigenous Law and Indigenous Development Areas (stage of BC Treaty Commission negotiation process)	Land claims (ie. Treaty established, Recognized by BCTC, asserted but not recognized)	Km to Resource Area	Community action	Community action (KWL & GeothermEx 2015 data)	Surface Rights (KWL & GeothermEx 2015 data)	Visual considerations	Hot Spring Tourism (Woodsworth and Woodsworth, 2014)	General Tourism (KWL & GeothermEx 2015 data)	Traditional use area
L. Mt. Garibaldi	Whistler			25 km		• In 2001, Squamish Nation developed the sacred land use plan that identifies four types of land use zones: forest stewardship zones, sensitive areas, restoration areas and wild spirit places. (http://www.squamish.net/about-us/our-land/xay-temixw-sacred-land-land-use-plan/) No actual maps or PDFs of the plan are provided. • Squamish Community Development Plan provides priority development areas along with method of funding. (httpsquamishfamilymeeting.com) • Government of BC provided funding in 2013 to assess renewable energy potential in the Traditional Territory of Squamish Nation. (http://www.newsroom.gov.bc.ca/2013/03/clean-energy-opportunities-for-11-first-nations-communities.html).		Logging areas and roads. Garibaldi, Alice Lake Provincial Park recreational activities nearby.	no hot spring tourism in the nearby area (closest are near Meager Creek and Sloquet areas)	• Squamish Nation traditional territory encompasses significant existing tourism areas. The majority of tourism opportunities are related to outdoor recreation and includes sacred sites such as the popular hiking area of Stawamus Chief. The Squamish Nation Land use plan emphasizes the "need for more training and meaningful employment opportunities for Squamish Nation Members, especially from forestry and Tourism" (http://www.squamish.net/about-us/our-land/xay-temixw-sacred-land-land-use-plan/) • Proposed plant location is within 2 km of popular outdoor recreation area of Cat Lake and Alice Lake Provincial Park.	trapping, hunting, food and medicinal plants, fishing activities; Community sacred site, gathering place or event site; archeology sites and other areas of significance; CONSULT THE LISTED COMMUNITIES FOR COMMUNITY-SPECIFIC TRADITIONAL USES OF THE SITE
	Squamish Nation	BCTC Stage 3: Squamish Nation	within Squamish Nation SOI (http://www.bctreaty.net/nations/soi_maps/Squamish_01_SOI_Map.pdf).	90 km							
M. Mount Silverthrone - Knight Inlet	Da'naxda'xw/Awaetlala First Nation	BCTC Stage 4: Da'naxda'xw Framework Agreement signed Sep 25, 2000 (http://www.bctreaty.net/nations/tanakteuk.php)	within Da'naxda'xw/Awaetlala's SOI map (http://www.bctreaty.net/nations/soi_maps/DanaxdaxwNation_SOI_Map.pdf).	105 km		• Da'naxda'xw First Nation is challenging BC Ministry of Mines and Natural Gas in relation to a hydro-electric power project within traditional territory (2015) • Campbell River Official Community Plan includes community energy and emissions plan reference to reduce greenhouse gas emissions, more sustainably manage energy and explore renewable energy opportunities in Campbell River; includes renewable energy under economic development (Campbell River Official Community Plan)(http://www.blg.com/en/newsandpublications/publication_3667) • Powerline routing will impact We Wai Kai and We Wai Kum First Nation as well.		Remote location, logging roads not in immediate area of resource and will likely require upgrading.	Canyon Lake (Sixth Lake) Hot springs are located on the Klinaklini, best reached by floatplane. Hoodoo Creek Hot Springs are spectacular and hot, difficult to reach and provides no soaking opportunities.	• Knight Inlet Special Management Zone provides grizzly bear viewing potential; grizzly tours are available from a number of tour companies (http://grizzlycanada.com/knightinlet/) • Ecotourism area includes hiking, kayaking, wildlife tours.	trapping, hunting, food and medicinal plants, fishing activitie; Community sacred site, gathering place or event site; archeology sites and other areas of significance; CONSULT THE LISTED COMMUNITIES FOR COMMUNITY-SPECIFIC TRADITIONAL USES OF THE SITE
	Nanwakolas First Nation	not currently negotiating with BCTC although some bands are involved in the process independently or as part of a treaty group. Made up of the: Mamalilikulla Qwe'Qwa'Sot'Em, Tlowitsis, Da'naxda'xw Awaetlatla, We Wai Kum, Kwiakah and K'omoks First Nations).	within asserted territory (http://www.nanwakolas.com/sites/default/files/Map%20Traditional%20Territories%20of%20NC%20MEM%20FN%208X11%20feb%205%202014.jpg)	various but >90 km								
	Tl'etinqox-T'in Government Office (Anaham Band)	member of Tsilhqot'in National government	within asserted territory (http://www.nanwakolas.com/sites/default/files/Map%20Traditional%20Territories%20of%20NC%20MEM%20FN%208X11%20feb%205%202014.jpg)								
	Tsilhqot'in National Government	Government representatives are working to build relationships with the Tsilhqot'in National Government (TNG) member bands outside of the BCTC 6-stage treaty process. Members include Tl'etinqox, ?Esdilagh, Yunesiti'in, Tl'esqox, Tsi Del Del, Xeni Gwet'in. http://www2.gov.bc.ca/gov/content/environment/natural resource-stewardship/consulting-with-first-nations/first-nations-negotiations/first-nations-a-z-listing/tsilhqot-in-national-government	extent of Tsilhqot'in asserted territory is about 40 km away ((Schedule A in http://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/consulting-with-first nations/agreements/other-docs/nenqay_deni_accord.pdf)								
	Ulkatcho First Nations	not currently negotiating with BCTC. Member of Carrier Chilcotin Tribal Council - government representatives are working to build relationships with the Carrier Chilcotin Tribal Council's 4 member bands outside of the BC treaty process.	asserted territory not known	135 km							

Resource Area	Communities Nearby	Indigenous Law and Indigenous Development Areas (stage of BC Treaty Commission negotiation process)	Land claims (ie. Treaty established, Recognized by BCTC, asserted but not recognized)	Km to Resource Area	Community action	Community action (KWL & GeothermEx 2015 data)	Surface Rights (KWL & GeothermEx 2015 data)	Visual considerations	Hot Spring Tourism (Woodsworth and Woodsworth, 2014)	General Tourism (KWL & GeothermEx 2015 data)	Traditional use area
N. Nazko Cone	Carrier Chilcotin Tribal Council	not currently negotiating with BCTC; members include Lhoosk'uz Dene, Lhtako Dene, Toosey, Ulkatcho. Member of Carrier Chilcotin Tribal Council - government representatives are working to build relationships with the Carrier Chilcotin Tribal Council's 4 member bands outside of the BC treaty process.	asserted territory not known			• Quesnel Climate Change Group was developed in 2007 to mitigate the effects of climate change in their environment (http://www.bakercreek.org/Climate-Change-Group.html). • City of Quesnel CHP community energy system feasibility study (http://www.toolkit.bc.ca/success-story/city-quesnel-conducts-final-feasiblity-study-innovative-community-energy-system-north-cariboo)		Logging areas and roads. Puntchesakut Lake and Pinnacles Provincial park <5 km from potential resource location. These parks are small.	no hot spring tourism nearby.	• Several Provincial Parks surround Quesnel and the proposed project location. Significant ecotourism industry including fly-fishing, canoeing, cross-country skiing, kayaking (http://www.tourismquesnel.com/home/)	trapping, hunting, food and medicinal plants, fishing activities; Community sacred site, gathering place or event site; archeology sites and other areas of significance; CONSULT THE LISTED COMMUNITIES FOR COMMUNITY-SPECIFIC TRADITIONAL USES OF THE SITE
	Lhoosk'uz Dene Nation	not currently negotiating with BCTC. Member of Carrier Chilcotin Tribal Council - government representatives are working to build relationships with the Carrier Chilcotin Tribal Council's 4 member bands outside of the BC treaty process.	asserted territory not known	55 km							
	Lhtako Dene Nation	not currently negotiating with BCTC. Member of Carrier Chilcotin Tribal Council - government representatives are working to build relationships with the Carrier Chilcotin Tribal Council's 4 member bands outside of the BC treaty process.	asserted territory not known	85 km							
	Nazko First Nation	BCTC Stage 4: Nazko Framework Agreement signed June 15, 1999 (http://bctreaty.net/nations/agreements/nazko_frmwrk.pdf), in Agreement-In-Principle stage.	within Nazko First Nation SOI (http://bctreaty.net/nations/soi_maps/Nazko_Indian_Band_SOI_Map.pdf)	10 km	Was very involved in the Project's community research-capacity building process and gave detailed interviews. They were also part of Kunkel's PhD study about the relationship between local, renewable energy and development of Aboriginal communities.						
	Tsilhqot'in National Government	Government representatives are working to build relationships with the Tsilhqot'in National Government (TNG) member bands outside of the BCTC 6-stage treaty process. Members include Tl'etinqox, ?Esdilagh, Yunesiti'in, Tl'esqox, Tsi Del Del, Xeni Gwet'in. http://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/consulting-with-first-nations/first-nations-negotiations/first-nations-a-z-listing/tsilhqot-in-national-government	within Tsilhqot'in asserted territory (Schedule A in http://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/consulting-with-first-nations/agreements/other-docs/nenqay_deni_accord.pdf)								

Resource Area	Communities Nearby	Indigenous Law and Indigenous Development Areas (stage of BC Treaty Commission negotiation process)	Land claims (ie. Treaty established, Recognized by BCTC, asserted but not recognized)	Km to Resource Area	Community action	Community action (KWL & GeothermEx 2015 data)	Surface Rights (KWL & GeothermEx 2015 data)	Visual considerations	Hot Spring Tourism (Woodsworth and Woodsworth, 2014)	General Tourism (KWL & GeothermEx 2015 data)	Traditional use area
O. Okanagan	Coldwater	part of Nicola Tribal Association, not currently in negotiation with BCTC	Nicola Tribal Association asserted territory not known	75 km							
	Cook's Ferry	part of Nicola Tribal Association, not currently in negotiation with BCTC	Nicola Tribal Association asserted territory not known	130 km							
	Lower Nicola	affiliated with Nicola Tribal Association (but not part of), not currently in negotiation with BCTC	Lower Nicola First Nation asserted territory not known	85 km							
	Lower Similkameen	part of Okanagan Nation Alliance, not currently in negotiation with BCTC	Not currently in negotiation with BCTC, but asserts claim to: http://www.syilx.org/wordpress/wp-content/themes/ONA/images/ON_Territory.pdf	70 km							
	Lytton	part of Nlaka'pamux nation, not currently in negotiation with BCTC	Nlaka'pamux Nation asserted territory is <25 km from resource area: http://www.nntc.ca/docs/nntc_territory_map.pdf	135 km							
	Nicola Tribal Association	not currently in negotiation with BCTC	Nicola Tribal Association asserted territory not known								
	Nlaka'pamux Nation	not currently in negotiation with BCTC	Nlaka'pamux Nation asserted territory is <25 km from resource area: http://www.nntc.ca/docs/nntc_territory_map.pdf	135-145 km							
	Nooaitch	part of Nicola Tribal Association, not currently in negotiation with BCTC	Nicola Tribal Association asserted territory not known	100 km							
	Okanagan Nation Alliance	not currently in negotiation with BCTC	Not currently in negotiation with BCTC, but asserts claim to: http://www.syilx.org/wordpress/wp-content/themes/ONA/images/ON_Territory.pdf	various, but >70 km		• The Okanagan Nation Alliance is developing processes to ensure "communities are not mere stakeholders to a resource...[but] are stewards of our lands and waters." (http://www.syilx.org/operations/natural-resourcesland-use/).					trapping, hunting, food and medicinal plants, fishing activities; Community sacred site, gathering place or event site; archeology sites and other areas of significance; CONSULT THE LISTED COMMUNITIES FOR COMMUNITY-SPECIFIC TRADITIONAL USES OF THE SITE
	Okanagan	part of Okanagan Nation Alliance, not currently in negotiation with BCTC	Not currently in negotiation with BCTC, but asserts claim to: http://www.syilx.org/wordpress/wp-content/themes/ONA/images/ON_Territory.pdf	90 km					Angel (KLO) Warm Springs (23-32C) is about 20 km southeast of Kelowna. Extensive tufa deposits, pleasant hike but springs are too cool and unattractive for soaking.		
	Oregon Jack Creek	part of Nlaka'pamux nation, not currently in negotiation with BCTC	Nlaka'pamux Nation asserted territory is <25 km from resource area: http://www.nntc.ca/docs/nntc_territory_map.pdf	145 km							
	Penticton	part of Okanagan Nation Alliance, not currently in negotiation with BCTC	Not currently in negotiation with BCTC, but asserts claim to: http://www.syilx.org/wordpress/wp-content/themes/ONA/images/ON_Territory.pdf	30 km							
	Siska	part of Nicola Tribal Association, not currently in negotiation with BCTC	Nicola Tribal Association asserted territory not known	130 km							
	Summerland			20 km		• Summerland Official Community Plan provides growth areas (See Summerland Official Community Plan and maps) • Summerland created Climate Action Plan in 2011 and signed onto the BC Climate Action Charter (http://www.summerland.ca/planning-building/climate-action)				• Summerland has a significant ecotourism industry; four Provincial Park protected areas are within 6 km of the location of the proposed plant and transmission line.	
	Westbank	BCTC Stage 4: Westbank Framework agreement: http://www.bctreaty.net/nations/agreements/westbank_frmwrk.pdf	within Westbank SOI area: http://www.bctreaty.net/nations/soi_maps/Westbank_SOI_Map.pdf	30 km		• Westbank First Nation provides Land Use Plan for communities including Summerland • Westbank First Nation Community Plan supports the protection and enhancement of sensitive natural environmental areas					

Resource Area	Communities Nearby	Indigenous Law and Indigenous Development Areas (stage of BC Treaty Commission negotiation process)	Land claims (ie. Treaty established, Recognized by BCTC, asserted but not recognized)	Km to Resource Area	Community action	Community action (KWL & GeothermEx 2015 data)	Surface Rights (KWL & GeothermEx 2015 data)	Visual considerations	Hot Spring Tourism (Woodsworth and Woodsworth, 2014)	General Tourism (KWL & GeothermEx 2015 data)	Traditional use area
P. Sloquet Hot Springs	Douglas	BCTC Stage 5: In-SHUCK-ch Nation Agreement in Principle was signed Aug 2007, and the parties are in Final Agreement negotiations.	within In-SHUCK-ch SOI: http://www.bctreaty.net/nations/soi_maps/In-shuck-ch_SOI_Map.pdf	10 km		• Sloquet Hot Springs is run as a joint venture between the Government of BC and First Nations. In 2010 improvement benefits to the Harrison West Forest Service Road were investigated. • St'at'imc community upgrades to the hot springs are ongoing (http://www.indigenousworkforce.org/projects/weekend-warrior-projects/) • Mission Official Community Plan completed in 2008 includes goal to achieve sustainable growth; balancing economic, environmental and social principals (Mission Official Community Plan).	• Significant protected habitat with St'at'imc Land and Resources Authority - SLRA (www.statimc.net)		One of the best in Lillooet River valley, but can be crowded. It is located about 90 km south of Pemberton.	• Sloquest Hot Springs is an existing tourist destination with campground and hiking trails. (http://whistlerhiatus.com/driving/sloquet-hot-springs-126k.html) • Proposed location is accessed via remote forest service roads, however, is relatively close to densely populated greater Vancouver; potential for more use pending reliable access roads.	trapping, hunting, food and medicinal plants, fishing activities; Community sacred site, gathering place or event site; archeology sites and other areas of significance; CONSULT THE LISTED COMMUNITIES FOR COMMUNITY-SPECIFIC TRADITIONAL USES OF THE SITE
	In-SHUCK-ch Nation	BCTC Stage 5: In-SHUCK-ch Nation Agreement in Principle was signed Aug 2007, and the parties are in Final Agreement negotiations. Includes Douglas, Skatin and Samahquan First Nations.	within In-SHUCK-ch SOI: http://www.bctreaty.net/nations/soi_maps/In-shuck-ch_SOI_Map.pdf	10 - 65 km	geothermal mentioned in http://inshuckch.com/wp-content/uploads/2015/10/LandStewardshipPlan.pdf						
	Kwantlen	BCTC Stage 4: Sto:Lo Treaty Association (represents both Sto:lo Nation and Sto:lo Tribal Council? Kwantlen is part of Sto:lo Tribal Council) Framework agreement signed Jan30, 1998: http://www.bctreaty.net/nations/agreements/stolo_framewrk.pdf	within Sto:Lo Nation SOI (map not available on BCTC website, but outline is in shapefile)	65 km							
	Lillooet Tribal Council, aka or part of St'at'imc Chiefs Council ?	not currently in negotiation with BCTC	within asserted territory by St'at'imc Chiefs Council: http://www.statimc.net/	various							
	Samahquan	BCTC Stage 5: In-SHUCK-ch Nation Agreement in Principle was signed Aug 2007, and the parties are in Final Agreement negotiations.	within In-SHUCK-ch SOI: http://www.bctreaty.net/nations/soi_maps/In-shuck-ch_SOI_Map.pdf	30 km	geothermal mentioned in http://inshuckch.com/wp-content/uploads/2015/10/LandStewardshipPlan.pdf						
	Seabird Island	BCTC Stage 4: Sto:Lo Treaty Association (represents both Sto:lo Nation and Sto:lo Tribal Council? Seabird Island is part of Sto:lo Tribal Council) Framework agreement signed Jan30, 1998: http://www.bctreaty.net/nations/agreements/stolo_framewrk.pdf	within Sto:Lo Nation SOI (map not available on BCTC website, but outline is in shapefile)	65 km							
	Skatin	BCTC Stage 5: In-SHUCK-ch Nation Agreement in Principle was signed Aug 2007, and the parties are in Final Agreement negotiations.	within In-SHUCK-ch SOI: http://www.bctreaty.net/nations/soi_maps/In-shuck-ch_SOI_Map.pdf	25 km	geothermal mentioned in http://inshuckch.com/wp-content/uploads/2015/10/LandStewardshipPlan.pdf						
	St'at'imc Chiefs Council	not currently in negotiation with BCTC	within asserted territory by St'at'imc Chiefs Council: http://www.statimc.net/	various, but >10 km							
	Sto:lo Nation	BCTC Stage 4: Sto:Lo Treaty Association (represents both Sto:lo Nation and Sto:lo Tribal Council?) Framework agreement signed Jan30, 1998: http://www.bctreaty.net/nations/agreements/stolo_framewrk.pdf	within Sto:Lo Nation SOI (map not available on BCTC website, but outline is in shapefile)	40 - 65 km							
	Sts'ailes	not currently in negotiation with BCTC	within asserted territory by Sts'ailes: http://www.stsailes.com/downloads/traditional-territory-map.jpg	55 km							

Resource Area	Communities Nearby	Indigenous Law and Indigenous Development Areas (stage of BC Treaty Commission negotiation process)	Land claims (ie. Treaty established, Recognized by BCTC, asserted but not recognized)	Km to Resource Area	Community action	Community action (KWL & GeothermEx 2015 data)	Surface Rights (KWL & GeothermEx 2015 data)	Visual considerations	Hot Spring Tourism (Woodsworth and Woodsworth, 2014)	General Tourism (KWL & GeothermEx 2015 data)	Traditional use area
Q. Sphaler Creek	Iskut Band	not currently in negotiation with BCTC; government representatives are working to build relationships with the Tahltan Band Council and Iskut First Nations (its members) outside the BC treaty process through the Tahltan Central Council.	asserted territory: Tahltan territory is located in northern British Columbia, Canada and encompasses about 93,500 km2. The north/western border runs parallel to the Alaskan/Canadian border, and includes part of the Yukon Territory. The south/eastern border includes the upper Nass tributaries and western half of the Stikine plateau, including the sacred headwaters of the Stikine, Nass and Skeena rivers.	115 km	opposition against coal mining development (http://iskut.org/press-coverage/tahltan-nation-welcomes-halt-klappan-coal-permitting/)	• Iskut Band Council (http://iskut.org/) does not provide any specific community/environmental planning agendas			Sphaler Hot Springs are located near the head of Sphaler Creek, a large tributary of Stikine River. Best access is by helicopter from Dease Lake or Stewart. Area to the north has seen renewed interest in gold exploration and development. A proposed mine in the Galore Creek area would require a road from Bob Quinn Lake on Highway 37 to the mine site, and the road would run along parts of Sphaler Creek, possibly close to the springs. Several other hot springs in the area are just as tough or tougher to reach: Mess Creek, Mess Lake, Sezill (Taweh Creek), Elwyn Creek, and Choquette Springs.	• Bob Quinn Lake Airport is near proposed project location. Schoquette Hot Springs is near Stikine, BC. Proposed project location is remote; no significant infrastructure in within extent of project, although Bob Quinn Lake is a recreational outdoors park.	trapping, hunting, food and medicinal plants, fishing activities; Community sacred site, gathering place or event site; archeology sites and other areas of significance; CONSULT THE LISTED COMMUNITIES FOR COMMUNITY-SPECIFIC TRADITIONAL USES OF THE SITE
	Tahltan Indian Band	not currently in negotiation with BCTC; government representatives are working to build relationships with the Tahltan Band Council and Iskut First Nations (its members) outside the BC treaty process through the Tahltan Central Council.	asserted territory: Tahltan territory is located in northern British Columbia, Canada and encompasses about 93,500 km2. The north/western border runs parallel to the Alaskan/Canadian border, and includes part of the Yukon Territory. The south/eastern border includes the upper Nass tributaries and western half of the Stikine plateau, including the sacred headwaters of the Stikine, Nass and Skeena rivers.	95 km	opposition against coal mining development (http://iskut.org/press-coverage/tahltan-nation-welcomes-halt-klappan-coal-permitting/)	• Tahltan Heritage Resources Environmental Assessment Team (THREAT) established in 2005 to support protection of the environmental, social, cultural, heritage and economic interests. (http://www.tahltan.org/administration/threat) • 2005 community action stopped Shell Canada test well activities. • Tahltan Nation plan is in development (started 2011); broad issues that have been identified include better community infrastructure (particularly Bob Quinn and Dease Lake), managing social-culture growth. (http://www.tahltan.org/news/tahlta		No existing road access nearby (>30 km away).			

APPENDIX C: Expanded Geothermal Development Decision Matrix (GDDM) Section H - Community Issues

Resource Area	Communities Nearby	Indigenous Law and Indigenous Development Areas (stage of BC Treaty Commission negotiation process)	Land claims (ie. Treaty established, Recognized by BCTC, asserted but not recognized)	Km to Resource Area	Community action	Community action (KWL & GeothermEx 2015 data)	Surface Rights (KWL & GeothermEx 2015 data)	Visual considerations	Hot Spring Tourism (Woodsworth and Woodsworth, 2014)	General Tourism (KWL & GeothermEx 2015 data)	Traditional use area
R. Upper Arrow Lake	Secwepemc Nation	BCTC Stage 4: Northern Shuswap Tribal Council has BCTC SOI. Represent 17 First Nation communities. Made up of Northern Shuswap Tribal Council (4 communities: Canim Lake, Canoe & Dog Creek, Soda & Deep Lake, Williams Lake), and Shuswap Nation (9 communities: Adams Lake, Bonaparte, Neskonlith, Shuswap, Simpcw, Skeetchestn, Splatsin, Tk'emlups, Whispering Pines).	Northern Shuswap Tribal Council has BCTC SOI (stage 4 within BCTC treaty process) within 100 km of resource area: http://www.bctreaty.net/nations/documents/SOIMap-AmendedMay2014.pdf	various but >95 km		• Perry Ridge Wilderness Initiative - united campaign with Perry Ridge Water Users Association to protect Perry Ridge in the Slocan Valley (http://www.perryridge.org/about-perry-ridge/overview/) • 2010 - Injunction against Sinixt protest for Perry Ridge overturned by Vancouver court • 2013 Sinixt Nation receives notice of trespass at Perry Ridge • Challenge to Pass Creek logging • Nakusp Community Plan: "The Hot Springs resource is enhanced, protected and economically sustainable (Nakusp Community Plan) ALSO within Sinixt, Ktunaxa asserted territories (not BCTC process)		Logging areas and roads nearby, Arrow Lakes is a reservoir lake.	Halcyon Hot Springs is a commercial resort open all year round, 35 km north of Nakusp. Nakusp Hot Springs is a small commercial resort located just outside Nakusp, open all year round. A total of 4 undeveloped springs are also in the area, Halfway River (good springs but becoming overused, rough road), Upper Halfway River (small but good springs, tough approach), St. Leon (excellent and popular pool) and Little Wilson Lake springs (poor soaking).	• Halcyon hot springs in Nakusp is tourist destination. Large tourist industry due to proximity to Revelstoke and variety of outdoor recreational activities available. • Nakusp Tourism (http://nakusparrowlakes.com/) • Nakusp regional interests include ecosystem integrity and water and shoreline access for recreation.	trapping, hunting, food and medicinal plants, fishing activities; Community sacred site, gathering place or event site; archeology sites and other areas of significance; CONSULT THE LISTED COMMUNITIES FOR COMMUNITY-SPECIFIC TRADITIONAL USES OF THE SITE
	Okanagan	part of Okanagan Nation Alliance, not currently in negotiation with BCTC	Not currently in negotiation with BCTC, but asserts claim to: http://www.syilx.org/wordpress/wp-content/themes/ONA/images/ON_Territory.pdf	105 km							
	Splats'in	part of Secwepemc Nation, not currently in negotiation with BCTC	Secwepemc traditional territory (not part of BCTC): http://landoftheshuswap.com/map/mapcompressed2ab.htm	95 km							
	Neskonlith	part of Secwepemc Nation, not currently in negotiation with BCTC	Secwepemc traditional territory (not part of BCTC): http://landoftheshuswap.com/map/mapcompressed2ab.htm	140 km	5-year community economic plan 2010-2015: interest in forestry; gardens/markets; re-opening greenhouses; crop production; rustic resort; industrial development; Green business code						
	Lower Similkameen	part of Okanagan Nation Alliance, not currently in negotiation with BCTC	Not currently in negotiation with BCTC, but asserts claim to: http://www.syilx.org/wordpress/wp-content/themes/ONA/images/ON_Territory.pdf	205 km							
	Upper Nicola	part of Okanagan Nation Alliance, and Nicola Tribal Association, not currently in negotiation with BCTC	Not currently in negotiation with BCTC, but asserts claim to: http://www.syilx.org/wordpress/wp-content/themes/ONA/images/ON_Territory.pdf	175 km							
	Penticton	part of Okanagan Nation Alliance, not currently in negotiation with BCTC	Not currently in negotiation with BCTC, but asserts claim to: http://www.syilx.org/wordpress/wp-content/themes/ONA/images/ON_Territory.pdf	170 km							
	Little Shuswap	part of Secwepemc Nation, not currently in negotiation with BCTC	Secwepemc traditional territory (not part of BCTC): http://landoftheshuswap.com/map/mapcompressed2ab.htm	135 km							
	Adams Lake	part of Secwepemc Nation, not currently in negotiation with BCTC	Secwepemc traditional territory (not part of BCTC): http://landoftheshuswap.com/map/mapcompressed2ab.htm	140 km							

APPENDIX D:
Completed Geothermal Development Decision Matrix

APPENDIX D: Geothermal Development Decision Matrix (GDDM) summary and resource areas

	Development Factor (Name of region/area) MW reported from KWL & Geothemex 2015	Suggested favourability for Direct-use	Transmission Line	Finance & Regulations	Environmental	Community	Resource	Roading access & Constructability	Weighted Total		
			F	D+E+G+L	C	H	A+B+M	I+J+K+N			
			1	2	3	5	5	3	19	Ranking	Comments
A	Canoe Creek - Valemount (15 MW)	high	0.5	3.0	2.3	3.1	4.0	3.3	59.0	3.10	Receptive community; financial and technical support needed
B	Clarke Lake (34 MW)	high	1.5	2.4	3.8	3.8	4.1	3.3	66.8	3.52	Receptive community; financial and technical support needed
C	Clearwater (10 MW)	low	0.5	1.1	1.5	2.7	2.3	2.7	40.1	2.11	Temp. grad. work in the N. Thompson valley to confirm high heat flow; results might change ranking significantly.
D	Iskut (10 MW)	low	0.5	2.7	0.8	2.3	2.9	2.7	42.3	2.23	Remote location with limited population and development: new geochem Taweh (Sezill) (thanks to Polaris Infrastructure)
E	Jedney area (15 MW)	high	0.5	2.4	3.5	3.1	3.9	2.7	58.6	3.09	Remote location with limited population and development potential.
F	King Island (20 MW)	moderate	0.5	2.2	2.0	2.7	3.4	2.3	48.2	2.54	Remote site; established lodge for sale (as of March 2016)
G	Kootenay (20 MW)	moderate	2.5	2.4	2.0	2.8	3.8	3.5	56.8	2.99	Ainsworth may be open to Direct-use applications; new geochem Wildhorse (thanks to Polaris Infrastructure)
H	Lakelse Lake (20 MW)	high	1.0	2.0	2.5	2.6	4.1	4.5	59.5	3.13	Electrical generation project underway; potential for Direct-use
I	Lower Arrow Lake (20 MW)	moderate	1.8	2.2	3.3	2.4	3.5	3.1	54.9	2.89	Remote location with limited population and development
J	Mount Meager (100 - 200 MW)	high	3.0	2.8	2.0	2.7	4.3	3.0	58.4	3.08	Remote site; new hydro project and transmission; upgraded access to Pebble Creek HS
K	Mt. Cayley (50 MW)	moderate	0.5	2.4	3.0	2.8	3.8	2.7	55.1	2.90	Remote site; good access; new chemistry for Turbid Creek HS (thanks to Polaris infrastructure).
L	Mt. Garibaldi (50 MW)	moderate	1.5	2.9	3.0	2.8	2.7	3.6	54.5	2.87	Slightly lower score than Cayley is due to lack of a defined resource.
M	Mt. Silverthrone (50 MW)	low	0.0	2.9	2.0	2.6	3.0	2.0	45.4	2.39	Remote location with no population
N	Nazko Cone (10 MW)	moderate	0.0	2.2	2.5	2.7	3.8	3.2	53.8	2.83	Remote location with limited population and development
O	Okanagan (20 MW)	high	0.5	2.4	2.8	2.9	3.6	3.8	57.3	3.01	Potentially receptive community, recreational area.
P	Sloquet Creek (10 MW)	high	3.8	2.4	3.0	2.9	3.6	3.1	59.5	3.13	Potentially receptive community, recreational area.
Q	Sphaler Creek (10 MW)	low	0.0	2.2	2.8	2.3	2.9	2.0	44.9	2.36	Remote location with limited population and development
R	Upper Arrow (20 MW)	moderate	0.5	2.2	2.0	3.0	3.7	3.2	53.7	2.83	new chemistry St. Leon & Taylor (thanks to Polaris Infrastructure)

*Weighting factors are based on an analysis of the developability of an area using available data. The weighting factors used were biased towards a likely resource with temperatures between 40 - 80 C (or higher) and a receptive community. Favourability (low, moderate, high) were assigned based on the weighted ranking. High, 3.00 and above, moderate between 3.00 and 2.50 and those below 2.50 were assigned a low.

GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
AREA OF INTEREST:	Canoe Creek - Valemount	
Nearest community name:	Valemount	
Nearest large community:	Kamloops	
Topographic map sheets (name and code) :	Canoe Mountain, 083D11	
Geological map sheets (name and code)	83D.065	

Canoe Creek - Valemount

A.	**Resource potential**		3.14
A.1	General geological setting		5
A.2	Size/potential/type	Lake Reservoir covers part of the area to assess	3
A.3	Temperature gradient/ Heat flow data		3
A.4	Water & Gas chemistry	Cl 320 mg/L, mixing waters. Medium concentrations of bicarbonate and sulphate.	3
A.5	Mineral indicators and/or surface alteration	none reported	0
A.6	Surface thermal features (type, temperature)	50-80C reported. Lake Reservoir covers thermal features most of the year. Mud pools have been submerged since dam construction.	5
A.7	Surface spring flow rates and Resource recharge	Need a better estimate of flow rates (reported 3L/s)	3
A.8	3D permeability (heat exchange potential)	Fracture permeability	3
A.9	Recent magmatism	No	0
A.10	Structural setting / seismic / tectonics	Lots of evidence of fracturing/faulting	3
A.11	Geophysics (type and interpretation if available)	2008 Quantech MT survey suggests alteration zone at 1000 m	5
A.12	Potential Resource host rocks	Fracture permeability	5
A.13	Potential drilling issues	Fractured rock	1
A.14	Brief description of geological setting of thermal features (i.e. springs emanate from fluvial gravels; beside a river; etc.)	This is an area of high heat flow and major structures. This may make it more favourable that just the surface expression of springs might indicate.	5
B.	**Exploration Uncertainty (Risk)**		4.00
B.1	Degree of identification of resources/reserves	Surface manifestations, but resource not defined; need to define depth of waters less than 80 C; Borealis recently signed a direct heat agreement that entails using the cooled waste water (~70 degrees Celsius) coming from the power plant after power generation for purposes such as sustaining a community greenhouse for food growth and possible public hot springs facilities	4
B.2	Likelihood of covering Resource with concession	lake coverage; Borealis holds permit	4
B.3	Expected authorization date	2016/2017	5
B.4	Specific timing of exploration (BC yr. by yr. to max 7 years)	Borealis acquired geothermal permit in 2011, ~4 years	4
B.5	Degree of previous exploration (can be good or bad)	In progress, no slim hole drilling yet	4
B.6	Surface Operational capacity (enough stable area for drilling and facilities planned?)	Reservoir covers part of the area; steep mountain valley	3
B.7	Exploration to exploitation (Difficult to easy)	In progress, favourable environment	4
C.	**Environmental Issues**		2.25
C.1	Protected areas (type and classification)	Cranberry Marsh/Starratt wildlife habitat 5 km from potential transmission connection location	3
C.2	Endangered species	Southern Mountain Cariboo habitat area ~2 km from proposed transmission route	2
C.3	Geothermal surface features	yes used for bathing	2
C.4	Other	fish bearing stream crossed by potential transmission/piping route, various wildlife habitat areas (Grizzly bear, spotted owl), 5-20 km away	2

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Canoe Creek - Valemount	
	Nearest community name:	Valemount	
	Nearest large community:	Kamloops	
	Topographic map sheets (name and code) :	Canoe Mountain, 083D11	
	Geological map sheets (name and code)	83D.065	
D.	**Geothermal Area - Bidding and/or type of land holding (private/gov/lease/etc.)**		3.67
D.1	Bidding Area	some permits dropped; Borealis state 2016/2017 to move forward on remaining permits. Permission to use Crown land is obtained by application under the Land Act (LA); target for Direct-use would be lower temperature < 80°C resource.	3
D.2	Electrical generation potential? Competition or collaboration possible from Companies present	KWL report	3
D.3	Other claim rights(Mining and/or Oil)	none known	5
E.	**Market**		5.00
E.1	Potential commodities for direct use applications	Village of Valemount is actively assessing Direct-use applications. Mushroom drying, forest products, greenhouses, direct heating/cooling etc.	5
E.2	Political stability and community relationship to development	Community engaged in economic evaluation	5
E.3	Time Limits? (Business agreements, Operating/generating-by deadlines?)	Current geothermal lease has been renewed and active exploration is underway (Borealis web site)	5
E.4	Renewable energy "green value" for potential development	Valemount has active interest in green value developments.	5
F.	**Transmission Line Infrastructure**		0.50
F.1	State of the Infrastructure	No transmission to the site of the springs (>20km away); pumps and other electrical equipment would have to run off of generators/solar/wind	1
F.2	Transmission route (distance, terrain and costs)	20 km piping distance; moderate slopes	1
F.3	Wheeling power	n/a	0
F.4	Transmission providers	n/a	0
G.	**Laws governing direct-use renewable energy sources**		3.43
G.1	General Criteria of the Geothermal Law	important aspect is the temperature criteria; under 80 C Crown Land Tenure; above geothermal law.	3
G.2	General Criteria of the water resources law	need a water use licence	3
G.3	Direct sales possible	yes, with a licence	3
G.4	Carbon credits	BC Carbon Registry (new, in place 2016), Carbon Tax	4
G.5	Lease time and ability to renew or extend exploration licence	Geothermal lease has been renewed once; could be done under crown land tenure for lower temperature resource (<80°C)	3
G.6	Issues (and timing) related to conversion from exploration to exploitation	If done under a geothermal lease specific work program is required.	3
G.7	Time frame for exploitation licence	Crown land tenure takes weeks to months, depending on the length of tenure requested; lease up to 30 years	5
H.	**Community Issues**		3.11
H.1	Indigenous Law and Indigenous Development Areas	different stages; two groups	1
H.2	Land claims	asserted territory of Lheidli (stage 5); Borealis does not have a MOU with Lheidli	1
H.3	Community action	Valemount actively looking at options	5

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Canoe Creek - Valemount	
	Nearest community name:	Valemount	
	Nearest large community:	Kamloops	
	Topographic map sheets (name and code) :	Canoe Mountain, 083D11	
	Geological map sheets (name and code)	83D.065	
H.4	Surface Rights	treaty and crown land	3
H.5	Visual considerations	lots of logging and forest service road access	5
H.6	Tourism	springs used, many other recreational activities nearby.	4
H.7	Traditional use area: trapping, hunting, food and medicinal plants, fishing activities	Lheidli, Simpcw, Shuswap, Neskonlith first nations group (Borealis has an MOU with Simpcw and Shuswap)	3
H.8	Traditional use area: Community sacred site, gathering place or event sites	Lheidli, Simpcw, Shuswap, Neskonlith first nations group (Borealis has an MOU with Simpcw and Shuswap)	3
H.9	Traditional use area: archeology sites and other areas of significance	Lheidli, Simpcw, Shuswap, Neskonlith first nations group (Borealis has an MOU with Simpcw and Shuswap)	3
I.	**Water rights**		5.00
I.1	availability for proposed development	2 active licenses on east side of Lake	5
I.2	availability for drilling	yes, with a licence	5
J.	**Engineering**		2.40
J.1	Development proposal and design	no reported progress	0
J.2	Construction issues	none reported	3
J.3	Transportation issues	none reported	3
J.4	Architectural Issues (blend/hide into environment? Local styles? Etc.)	none reported	3
J.5	Special construction issues (heat exchanger & full injection)	none reported	3
K.	**Non electrical infrastructure (roads and habitation)**		3.80
K.1	Nearest large community > 50,000	Kamloops is a major center for trades and material	4
K.2	nearest community and size	Valemount (1000 people)	2
K.3	Nearest road and condition	unpaved road	3
K.4	Current access conditions (restrictions)	unpaved roads; close enough to Valemount for staff	5
K.5	Terrain and distance factor for road building	no requirements for new roads	5
L.	**Development Finance**		0.00
L.1	Development value (greenhouses; tourism; heating; etc.)		0
L.2	Market price for similar commodities not using direct-use heat		0
L.3	Green power premium for commodity?		0
L.4	Commodity price		0
L.5	Marketing implications		0
L.6	Estimated size of resource		0
L.7	Are there any green use incentives?		0
L.8	Grants		0
L.9	Tax holidays		0
L.10	Tax relief		0
L.11	Loan guarantees		0
L.12	Royalties/Fees		0
L.13	General idea of royalties		0
L.14	Private land owner or government land		0
L.15	Tax rate in the country		0
L.16	Transmission Tariffs		0
M.	**Maps**		5.00

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Canoe Creek - Valemount	
	Nearest community name:	Valemount	
	Nearest large community:	Kamloops	
	Topographic map sheets (name and code) :	Canoe Mountain, 083D11	
	Geological map sheets (name and code)	83D.065	
M.1	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)		5
M.2	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks) (1:500,000?)		5
M.3	Regional geological map (1:250 or 500,000?)		5
M.4	Detailed geological map of the immediate area of the concessions (1:50,000 or 100,000)		5
N.	**Other issues and considerations**		2.00
N.1	Spatial concentration of potential customers	Valemount is a small community	2
N.2	Distance to market for prospective commodities	Kamloops and Edmonton closest markets	3
N.3	Costs to potential customers to receive Direct-use benefits	no subsidies	1

OVERALL COMMENTS/ASSESSMENT:	Valemount is actively interested in pursuing Direct-use applications. They have had workshops to investigate the options. They have looked at mushroom growing; greenhouses, and heating.

GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
AREA OF INTEREST:	Clarke Lake	
Nearest community name:	Fort Nelson	
Nearest large community:	Prince George	
Topographic map sheets (name and code) :	Jackfish Creek, 094J10	
Geological map sheets (name and code)	94J.078	

Clarke Lake

A.	**Resource potential**		4.21
A.1	General geological setting	well known	5
A.2	Size/potential/type	large (6.2 km3), reservoir temp estimated at 115C based on drill stem test (DST) records from natural gas wells (range 81 - 123C).	5
A.3	Temperature gradient/ Heat flow data	relatively high temp gradient (average measured 54C/km)	5
A.4	Water & Gas chemistry	Salinities approx. 35,000 ppm total dissolved solids. Natural gas from target formations contain 9.1% CO2 and 0.23% H2S.	3
A.5	Mineral indicators and/or surface alteration	N/A. Temp estimate based on direct measurements in DSTs.	5
A.6	Surface thermal features (type, temperature)		5
A.7	Surface spring flow rates and Resource recharge	No surface manifestations. Reported maximum from deepened natural gas well was 1,800 m3/day. Productivity of well drilled with larger diameter for geothermal production estimated 8,400 m3/day. Reservoir is reported to have strong reservoir recharge.	5
A.8	3D permeability (heat exchange potential)	high formation permeability	5
A.9	Recent magmatism		0
A.10	Structural setting / seismic / tectonics	Lots of evidence of fracturing/faulting	5
A.11	Geophysics (type and interpretation if available)	Seismic surveys available in area. Regional aeromagnetic surveys conducted for gas field identified main basements and fault trends.	5
A.12	Potential Resource host rocks	carbonate reef rocks	5
A.13	Potential drilling issues	Deep reservoir (average depth ~2,000 m). No known indication at shallower (i.e.. Lower temperature) depths.	1
A.14	Brief description of geological setting of thermal features (i.e. springs emanate from fluvial gravels; beside a river; etc.)	high formation permeability	5
B.	**Exploration Uncertainty (Risk)**		3.14
B.1	Degree of identification of resources/reserves	Extensive gas drilling. Less than 80C water aquifer location unknown.	3
B.2	Likelihood of covering Resource with concession	Reservoir has large area, well defined by natural gas drilling. No current geothermal permits.	5
B.3	Expected authorization date	No geothermal tracts nearby.	0
B.4	Specific timing of exploration (2 + 2 years, BC 8 years, etc.)	as soon as permits are in place, 5 years for a 5MW pilot plant (KWL report)	3
B.5	Degree of previous exploration (can be good or bad)	High degree of natural gas exploration, no specific work done for geothermal applications.	4
B.6	Surface Operational capacity (enough stable area for drilling and facilities planned?)	Sufficient level ground exists for development. Gas field operations provide some infrastructure.	5
B.7	Exploration to exploitation (Difficult to easy)	Existing wells not likely useful, may be usable for injections (case by case basis).	2
C.	**Environmental Issues**		3.75
C.1	Protected areas (type and classification)	Not nearby.	5
C.2	Endangered species	Canada Warbler, Southern Mountain Caribou, Cape May Warbler habitats <5 km away.	2
C.3	Geothermal surface features	nearest hot springs >150 km away. Resource is not dependent on nearby surface features.	5
C.4	Other	Wildlife Habitat Area allotted for Boreal Caribou is nearby (3.5km south of proposed transmission/piping route). No fish bearing streams crossed.	3

APPENDIX D: Geothermal Development Decision Matrix (GDDM) summary and resource areas

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Clarke Lake	
	Nearest community name:	Fort Nelson	
	Nearest large community:	Prince George	
	Topographic map sheets (name and code) :	Jackfish Creek, 094J10	
	Geological map sheets (name and code)	94J.078	
D.	**Geothermal Area - Bidding and/or type of land holding (private/gov/lease/etc.)**		3.00
D.1	Bidding Area	No geothermal tracts nearby. Permission to use Crown land is obtained by application under the Land Act (LA); target would be lower temperature < 80°C resource.	3
D.2	Electrical generation potential? Competition or collaboration possible from Companies present	See KWL report. Also, collaboration possible with natural gas development (co-produced fluids).	3
D.3	Other claim rights(Mining and/or Oil)	Within oil and gas management area and overlapping petroleum and natural gas tenures exist. No existing mineral, coal titles.	3
E.	**Market**		3.50
E.1	Potential commodities for direct use applications	Fort Nelson reserve area is <5km away (pop 3,900). Greenhouses, forest products, etc. Closest large community is Prince George.	3
E.2	Political stability and community relationship to development	Fort Nelson is developing a Water Management Plan. May be positive/negative.	3
E.3	Time Limits? (Business agreements, Operating/generating-by deadlines?)	None known	3
E.4	Renewable energy "green value" for potential development	GHGE targets (i.e.. Fort Nelson: https://nr.civicweb.net/Documents/DocumentDisplay.aspx?ID=51471)	5
F.	**Transmission Line Infrastructure**		1.50
F.1	State of the Infrastructure	10 km of new 138 kV transmission necessary	3
F.2	Transmission route (distance, terrain and costs)	~ 10 km piping distance, flat; potential wetland conditions and crossing Fort Nelson River necessary.	3
F.3	Wheeling power	n/a	0
F.4	Transmission providers	n/a	0
G.	**Laws governing direct-use renewable energy sources**		3.43
G.1	General Criteria of the Geothermal Law	important aspect is the temperature criteria; under 80 C Crown Land Tenure; above geothermal law.	3
G.2	General Criteria of the water resources law	need a water use licence	3
G.3	Direct sales possible	yes, with a licence	3
G.4	Carbon credits	BC Carbon Registry (new, in place 2016), Carbon Tax.	4
G.5	Lease time and ability to renew or extend exploration licence	lease has been renewed once; could be done under crown land tenure	3
G.6	Issues (and timing) related to conversion from exploration to exploitation	If done under a geothermal lease specific work program is required.	3
G.7	Time frame for exploitation licence	Crown land tenure takes weeks to months, depending on the length of tenure requested; lease up to 30 years	5
H.	**Community Issues**		3.78
H.1	Indigenous Law and Indigenous Development Areas	Treaty 8 land area, most certainty about land claims and indigenous development processes.	5
H.2	Land claims	Treaty 8 land area	5

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Clarke Lake	
	Nearest community name:	Fort Nelson	
	Nearest large community:	Prince George	
	Topographic map sheets (name and code) :	Jackfish Creek, 094J10	
	Geological map sheets (name and code)	94J.078	
H.3	Community action	Fort Nelson court challenge against Site C development. Fort Nelson developing Water Management Plan with community plan goals to protect environment from pollution of land, water and air. First Nations have various agreements with Oil & Gas, Forestry industries, and other land management agreements.	3
H.4	Surface Rights	treaty and crown land	3
H.5	Visual considerations	lots of logging, oil and gas, hydro, seismic development infrastructure	5
H.6	Tourism	Alaska highway tourism, seasonal due to harsh winters. Nearest hot springs offer limited soaking, not easily accessed.	4
H.7	Traditional use area: trapping, hunting, food and medicinal plants, fishing activities	Treaty 8 First Nations: Acho Dene Koe (NWT), Dene Tha' (AB), Doig River, Fort Nelson, Prophet River, West Moberly.	3
H.8	Traditional use area: Community sacred site, gathering place or event sites	Treaty 8 First Nations: Acho Dene Koe (NWT), Dene Tha' (AB), Doig River, Fort Nelson, Prophet River, West Moberly.	3
H.9	Traditional use area: archeology sites and other areas of significance	Treaty 8 First Nations: Acho Dene Koe (NWT), Dene Tha' (AB), Doig River, Fort Nelson, Prophet River, West Moberly.	3
I.	**Water rights**		5.00
I.1	availability for proposed development	Closest water license ~12 km away, 7 additional existing licenses nearby.	5
I.2	availability for drilling	yes, with a licence	5
J.	**Engineering**		2.40
J.1	Development proposal and design	no reported progress	0
J.2	Construction issues	None known	3
J.3	Transportation issues	None known	3
J.4	Architectural Issues (blend/hide into environment? Local styles? Etc.)	none known	3
J.5	Special construction issues (heat exchanger & full injection)	none known	3
K.	**Non electrical infrastructure (roads and habitation)**		3.80
K.1	Nearest large community > 50,000	Prince George is a major center for trades and material	4
K.2	nearest community and size	Fort Nelson (3900 people)	2
K.3	Nearest road and condition	unpaved road	3
K.4	Current access conditions (restrictions)	unpaved roads; close enough to Fort Nelson for staff	5
K.5	Terrain and distance factor for road building	no requirements for new roads	5
L.	**Development Finance**		0.00
L.1	Development value (greenhouses; tourism; heating; etc.)		0
L.2	Market price for similar commodities not using direct-use heat		0
L.3	Green power premium for commodity?		0
L.4	Commodity price		0
L.5	Marketing implications		0
L.6	Estimated size of resource		0
L.7	Are there any green use incentives?		0
L.8	Grants		0
L.9	Tax holidays		0

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Clarke Lake	
	Nearest community name:	Fort Nelson	
	Nearest large community:	Prince George	
	Topographic map sheets (name and code) :	Jackfish Creek, 094J10	
	Geological map sheets (name and code)	94J.078	
L.10	Tax relief		0
L.11	Loan guarantees		0
L.12	Royalties/Fees		0
L.13	General idea of royalties		0
L.14	Private land owner or government land		0
L.15	Tax rate in the country		0
L.16	Transmission Tariffs		0
M.	**Maps**		5.00
M.1	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)		5
M.2	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks) (1:500,000?)		5
M.3	Regional geological map (1:250 or 500,000?)		5
M.4	Detailed geological map of the immediate area of the concessions (1:50,000 or 100,000)		5
N.	**Other issues and considerations**		2.00
N.1	Spatial concentration of potential customers	Fort Nelson is closest community, small. Long distances.	2
N.2	Distance to market for prospective commodities	Prince George is a major center for trades and material, long distances.	3
N.3	Costs to potential customers to receive Direct-use benefits	no subsidies	1

OVERALL COMMENTS/ASSESSMENT	Clarke Lake has a significant resource and a fair population center that could utilize Direct-use for district heating or other applications. Given the extensive area of high heat flow in NE BC it is likely that waters <80 C could be found within an economic distance of the town site. Community has a planning document that includes a Green House Action Plan (June 2010) that states that geothermal energy is considered for the community. https://nr.civicweb.net/filepro/documents/90854?preview=38879

GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
AREA OF INTEREST:	Clearwater-Wells Gray	
Nearest community name:	Clearwater	
Nearest large community:	Kamloops	
Topographic map sheets (name and code) :	Mahood Lake, 092P16	
Geological map sheets (name and code)	92P.100	

Clearwater-Wells Gray

A.	**Resource potential**		1.50
A.1	General geological setting	well known	5
A.2	Size/potential/type	unknown	0
A.3	Temperature gradient/ Heat flow data	unknown	0
A.4	Water & Gas chemistry	unknown	0
A.5	Mineral indicators and/or surface alteration	Ray mineral and Clearwater springs are known to be geothermal	0
A.6	Surface thermal features (type, temperature)	Springs are cold springs related to faulting and subsurface flow under lava flows.	0
A.7	Surface spring flow rates and Resource recharge	unknown	0
A.8	3D permeability (heat exchange potential)	unknown	0
A.9	Recent magmatism		5
A.10	Structural setting / seismic / tectonics	Lots of evidence of fracturing/faulting	5
A.11	Geophysics (type and interpretation if available)	magnetic data available	0
A.12	Potential Resource host rocks	fractures related to young volcanism	3
A.13	Potential drilling issues	unknown	0
A.14	Brief description of geological setting of thermal features (i.e. springs emanate from fluvial gravels; beside a river; etc.)	unknown	3
B.	**Exploration Uncertainty (Risk)**		0.43
B.1	Degree of identification of resources/reserves	none identified	1
B.2	Likelihood of covering Resource with concession	Young volcanic features are within a provincial park.	0
B.3	Expected authorization date	No geothermal tracts nearby.	0
B.4	Specific timing of exploration (2 + 2 years, BC 8 years, etc.)	unlikely to be a resource in close proximity to the town; deep faulting in the N. Thompson is a potential target.	1
B.5	Degree of previous exploration (can be good or bad)	regional and thesis work around the area	1
B.6	Surface Operational capacity (enough stable area for drilling and facilities planned?)	Provincial Park	0
B.7	Exploration to exploitation (Difficult to easy)	Permitting process and First Nation consultations will be lengthy. Drilling will be 20km from surface manifestations.	0
C.	**Environmental Issues**		1.50
C.1	Protected areas (type and classification)	Wells Gray-Clearwater provincial park <2 km away (to the North) from townsite	0
C.2	Endangered species	Coast Mountain Draba, Oregon Willowherb, Southern Mountain Caribou habitats within to 10 km away from potential resource area.	2
C.3	Geothermal surface features	Clearwater hot springs ~11 km (inside provincial park) north of potential resource area.	2
C.4	Other	Fish bearing streams located along proposed transmission/piping route.	2
D.	**Geothermal Area - Bidding and/or type of land holding (private/gov/lease/etc.)**		1.00
D.1	Bidding Area	No geothermal tracts nearby; provincial park. Permission to use Crown land is obtained by application under the Land Act (LA); target would be lower temperature < 80°C resource.	1
D.2	Electrical generation potential? Competition or collaboration possible from Companies present	unlikely ; see KWL report.	1
D.3	Other claim rights(Mining and/or Oil)	none known but within Provincial Park	1

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Clearwater-Wells Gray	
	Nearest community name:	Clearwater	
	Nearest large community:	Kamloops	
	Topographic map sheets (name and code) :	Mahood Lake, 092P16	
	Geological map sheets (name and code)	92P.100	
E.	**Market**		0.25
E.1	Potential commodities for direct use applications	mushroom drying;	1
E.2	Political stability and community relationship to development	unknown	0
E.3	Time Limits? (Business agreements, Operating/generating-by deadlines?)	unknown, too much uncertainty	0
E.4	Renewable energy "green value" for potential development	unknown	0
F.	**Transmission Line Infrastructure**		0.50
F.1	State of the Infrastructure	major transmission route in the N. Thompson >30 km away	1
F.2	Transmission route (distance, terrain and costs)	30 km via existing paved road to Clearwater station. Moderate terrain.	1
F.3	Wheeling power	n/a	0
F.4	Transmission providers	n/a	0
G.	**Laws governing direct-use renewable energy sources**		2.29
G.1	General Criteria of the Geothermal Law	important aspect is the temperature criteria; under 80 C Crown Land Tenure; above geothermal law.	3
G.2	General Criteria of the water resources law	need a water use licence	3
G.3	Direct sales possible	yes, with a licence	3
G.4	Carbon credits	BC Carbon Registry (new, in place 2016), Carbon Tax	4
G.5	Lease time and ability to renew or extend exploration licence	no current lease; no lease target outside of park	0
G.6	Issues (and timing) related to conversion from exploration to exploitation	If done under a geothermal lease specific work program is required.	0
G.7	Time frame for exploitation licence	Crown land tenure takes weeks to months, depending on the length of tenure requested; lease up to 30 years; Provincial Park	3
H.	**Community Issues**		2.67
H.1	Indigenous Law and Indigenous Development Areas	BCTC stage 4 negotiation (Canim Lake);	1
H.2	Land claims	Simpcw and Neskonlith not in negotiation but claim the territory.	1
H.3	Community action	Neskonlith have a 5 year community plan; rustic resort and greenhouse (outside of Clearwater area).	5
H.4	Surface Rights	treaty and crown land, Provincial Park	3
H.5	Visual considerations	Logging; provincial park	1
H.6	Tourism	provincial park draws many visitors to experience wilderness values of the park.	4
H.7	Traditional use area: trapping, hunting, food and medicinal plants, fishing activities	Canim Lake, Simpcw, Neskonlith	3
H.8	Traditional use area: Community sacred site, gathering place or event sites	Canim Lake, Simpcw, Neskonlith	3
H.9	Traditional use area: archeology sites and other areas of significance	Canim Lake, Simpcw, Neskonlith	3
I.	**Water rights**		3.00
I.1	availability for proposed development	yes, if development is outside of park	3
I.2	availability for drilling	yes, if development is outside of park	3

APPENDIX D: Geothermal Development Decision Matrix (GDDM) summary and resource areas

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Clearwater-Wells Gray	
	Nearest community name:	Clearwater	
	Nearest large community:	Kamloops	
	Topographic map sheets (name and code) :	Mahood Lake, 092P16	
	Geological map sheets (name and code)	92P.100	
J.	**Engineering**		2.00
J.1	Development proposal and design	none identified	0
J.2	Construction issues	none known	3
J.3	Transportation issues	paved and gravel roads	3
J.4	Architectural Issues (blend/hide into environment? Local styles? Etc.)	provincial park so any structures would need to fit or blend into the surroundings.	1
J.5	Special construction issues (heat exchanger & full injection)	none known	3
K.	**Non electrical infrastructure (roads and habitation)**		3.80
K.1	Nearest large community > 50,000	Kamloops	4
K.2	nearest community and size	Clearwater (2331)	2
K.3	Nearest road and condition	paved and unpaved road	3
K.4	Current access conditions (restrictions)	no restrictions	5
K.5	Terrain and distance factor for road building	no requirements for new roads	5
L.	**Development Finance**		0.00
L.1	Development value (greenhouses; tourism; heating; etc.)		0
L.2	Market price for similar commodities not using direct-use heat		0
L.3	Green power premium for commodity?		0
L.4	Commodity price		0
L.5	Marketing implications		0
L.6	Estimated size of resource		0
L.7	Are there any green use incentives?		0
L.8	Grants		0
L.9	Tax holidays		0
L.10	Tax relief		0
L.11	Loan guarantees		0
L.12	Royalties/Fees		0
L.13	General idea of royalties		0
L.14	Private land owner or government land		0
L.15	Tax rate in the country		0
L.16	Transmission Tariffs		0
M.	**Maps**		5.00
M.1	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)		5
M.2	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks) (1:500,000?)		5
M.3	Regional geological map (1:250 or 500,000?)		5
M.4	Detailed geological map of the immediate area of the concessions (1:50,000 or 100,000)		5
N.	**Other issues and considerations**		2.00
N.1	Spatial concentration of potential customers	Clearwater is a small community, major industry is tourism.	2
N.2	Distance to market for prospective commodities	Good highway access to Kamloops and larger centres	3

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Clearwater-Wells Gray	
	Nearest community name:	Clearwater	
	Nearest large community:	Kamloops	
	Topographic map sheets (name and code) :	Mahood Lake, 092P16	
	Geological map sheets (name and code)	92P.100	
N.3	Costs to potential customers to receive Direct-use benefits	no subsidies	1

OVERALL COMMENTS/ASSESSMENT	Currently no action from the town/municipal council on Direct-use; local business installs ground based geothermal. Area of high heat flow with few TG wells.

GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
AREA OF INTEREST:	Iskut	
Nearest community name:	Iskut	
Nearest large community:	Prince George	
Topographic map sheets (name and code) :	Iskut River, 104G01	
Geological map sheets (name and code)	104G.009	

Iskut

A.	**Resource potential**		2.36
A.1	General geological setting	Area is remote mountainous region; young and long lived volcanism in Mt. Edziza area.	3
A.2	Size/potential/type	no specific reservoir - isolated hot springs	0
A.3	Temperature gradient/ Heat flow data	none known; area of high heat flow	3
A.4	Water & Gas chemistry	new data for Mess and Iskut from Polaris infrastructure (see geochemistry Appendix D).	3
A.5	Mineral indicators and/or surface alteration	none reported	0
A.6	Surface thermal features (type, temperature)	very hot ~74° C	5
A.7	Surface spring flow rates and Resource recharge	low; unknown	1
A.8	3D permeability (heat exchange potential)	nothing known; likely structurally controlled	1
A.9	Recent magmatism	Stikine volcanic belt (Northern Cordilleran Volcanic Province)	5
A.10	Structural setting / seismic / tectonics	young faulting and volcanism	5
A.11	Geophysics (type and interpretation if available)	none available	0
A.12	Potential Resource host rocks	fractured basement rocks	3
A.13	Potential drilling issues	remote difficult access	1
A.14	Brief description of geological setting of thermal features (i.e. springs emanate from fluvial gravels; beside a river; etc.)	Close proximity to Mt. Edziza; Bowser Basin to the east.	3
B.	**Exploration Uncertainty (Risk)**		1.29
B.1	Degree of identification of resources/reserves	reservoir not identified; likely fractured bedrock	1
B.2	Likelihood of covering Resource with concession	Spring within provincial park, if resource accessible outside of park area.	2
B.3	Expected authorization date	Unknown	0
B.4	Specific timing of exploration (7 years BC)	once permits are in place	3
B.5	Degree of previous exploration (can be good or bad)	Surface sampling, geological mapping	1
B.6	Surface Operational capacity (enough stable area for drilling and facilities planned?)	difficult terrain, no nearby infrastructure	1
B.7	Exploration to exploitation (Difficult to easy)	Difficult; little resource information	1
C.	**Environmental Issues**		0.75
C.1	Protected areas (type and classification)	Spring lies within a provincial park	0
C.2	Endangered species	Snow Pearlwort habitat area within 1 km of proposed transmission/piping route.	1
C.3	Geothermal surface features	Iskut spring (within Provincial Park); no pools, Mess Creek 50 km west	2
C.4	Other	remote area; fish-bearing streams; grizzly bear habitat; park established to protect species types and diversity.	0
D.	**Geothermal Area - Bidding and/or type of land holding (private/gov/lease/etc.)**		3.33
D.1	Bidding Area	Local mine development may provide potential development. No geothermal tracts nearby. Provincial Park. Permission to use Crown land is obtained by application under the Land Act (LA); target would be lower temperature < 80°C resource.	3
D.2	Electrical generation potential? Competition or collaboration possible from Companies present	See KWL report. Possible collaboration with mineral development.	2
D.3	Other claim rights(Mining and/or Oil)	mineral leases, but not nearby.	5

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Iskut	
	Nearest community name:	Iskut	
	Nearest large community:	Prince George	
	Topographic map sheets (name and code) :	Iskut River, 104G01	
	Geological map sheets (name and code)	104G.009	
E.	**Market**		1.50
E.1	Potential commodities for direct use applications	Locally gathered forest materials and logging	1
E.2	Political stability and community relationship to development	small communities; mining may promote more emphasis on green energy; community protests over some development.	2
E.3	Time Limits? (Business agreements, Operating/generating-by deadlines?)	no development in planning stage, limited population	2
E.4	Renewable energy "green value" for potential development	possible due to proximity of mining	1
F.	**Transmission Line Infrastructure**		0.50
F.1	State of the Infrastructure	power to Bob Quinn Lake, 25 km away	1
F.2	Transmission route (distance, terrain and costs)	69 kV line required 25 km via existing transmission line corridor and Galore Creek Mine road.	1
F.3	Wheeling power	n/a	0
F.4	Transmission providers	n/a	0
G.	**Laws governing direct-use renewable energy sources**		2.29
G.1	General Criteria of the Geothermal Law	important aspect is the temperature criteria; under 80°C Crown Land Tenure; above geothermal law.	3
G.2	General Criteria of the water resources law	need a water use licence	3
G.3	Direct sales possible	yes, with a licence	3
G.4	Carbon credits	BC Carbon Registry (new, in place 2016), Carbon Tax	4
G.5	Lease time and ability to renew or extend exploration licence	no geothermal leases; resource area is within protected Park	0
G.6	Issues (and timing) related to conversion from exploration to exploitation	If done under a geothermal lease specific work program is required.	0
G.7	Time frame for exploitation licence	Crown land tenure takes weeks to months, depending on the length of tenure requested; lease up to 30 years	3
H.	**Community Issues**		2.33
H.1	Indigenous Law and Indigenous Development Areas	Tahltan Central council; supports sustainable and responsible business development. Not currently in negotiation with BC Treaty Commission (high uncertainty)	1
H.2	Land claims	not currently negotiating, asserted claims by Tahltan and Iskut First Nations	1
H.3	Community action	Tahltan Nation Development Council. 2005 community action against Shell Canada.	3
H.4	Surface Rights	1910 Declaration of Tahltan tribe; Tahltan resource development policy	3
H.5	Visual considerations	remote wilderness area; logging; mining	3
H.6	Tourism	Tourism underexploited	1
H.7	Traditional use area: trapping, hunting, food and medicinal plants, fishing activities	the Tahltan people look to the land for sustenance, guidance and healing; http://www.tndc.ca/tahltan-people	3
H.8	Traditional use area: Community sacred site, gathering place or event sites	as above	3
H.9	Traditional use area: archeology sites and other areas of significance	as above	3
I.	**Water rights**		3.00

APPENDIX D: Geothermal Development Decision Matrix (GDDM) summary and resource areas

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Iskut	
	Nearest community name:	Iskut	
	Nearest large community:	Prince George	
	Topographic map sheets (name and code) :	Iskut River, 104G01	
	Geological map sheets (name and code)	104G.009	
I.1	availability for proposed development	Only active water license at Bob Quinn Lake. Possible if development is outside of Protected Park.	3
I.2	availability for drilling	yes, if development is outside Park.	3
J.	**Engineering**		2.40
J.1	Development proposal and design	no planning in progress	0
J.2	Construction issues	Unknown	3
J.3	Transportation issues	gravel roads and mining roads	3
J.4	Architectural Issues (blend/hide into environment?	none known; wilderness area	3
J.5	Special construction issues (heat exchanger & full injection)	none known; remote location	3
K.	**Non electrical infrastructure (roads and habitation)**		2.80
K.1	Nearest large community > 50,000	Prince George	4
K.2	nearest community and size	Iskut, Galore Creek, Bob Quinn Lake	2
K.3	Nearest road and condition	Galore Creek mining roads	2
K.4	Current access conditions (restrictions)	remote access via mining roads	3
K.5	Terrain and distance factor for road building	dependent on development and condition of existing Galore Creek Mine Road	3
L.	**Development Finance**		0.00
L.1	Development value (greenhouses; tourism; heating; etc.)		0
L.2	Market price for similar commodities not using direct-use heat		0
L.3	Green power premium for commodity?		0
L.4	Commodity price		0
L.5	Marketing implications		0
L.6	Estimated size of resource		0
L.7	Are there any green use incentives?		0
L.8	Grants		0
L.9	Tax holidays		0
L.10	Tax relief		0
L.11	Loan guarantees		0
L.12	Royalties/Fees		0
L.13	General idea of royalties		0
L.14	Private land owner or government land		0
L.15	Tax rate in the country		0
L.16	Transmission Tariffs		0
M.	**Maps**		5.00
M.1	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)		5
M.2	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks) (1:500,000?)		5
M.3	Regional geological map (1:250 or 500,000?)		5
M.4	Detailed geological map of the immediate area of the concessions (1:50,000 or 100,000)		5

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Iskut	
	Nearest community name:	Iskut	
	Nearest large community:	Prince George	
	Topographic map sheets (name and code) :	Iskut River, 104G01	
	Geological map sheets (name and code)	104G.009	
N.	**Other issues and considerations**		1.00
N.1	Spatial concentration of potential customers	very remote locations	0
N.2	Distance to market for prospective commodities	if mining is viable, potential for cooperation	3
N.3	Costs to potential customers to receive Direct-use benefits	high, no subsidies	0

OVERALL COMMENTS/ASSESSMENT	Area is remote; underutilized for tourism, hike to hot spring is difficult, very limited. Power line recently completed to Bob Quinn lake so some economic development is possible.

GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
AREA OF INTEREST:	Jedney	
Nearest community name:	Fort St. John	
Nearest large community:	Prince George	
Topographic map sheets (name and code) :	Medana Creek, 094G08	
Geological map sheets (name and code)	94G.029	

Jedney

A.	**Resource potential**		3.50
A.1	General geological setting	actual reservoir has not been defined	5
A.2	Size/potential/type	good likelihood of 40 - 60 45°C waters within 1-2 km of surface; unknown permeability or formation target.	5
A.3	Temperature gradient/ Heat flow data	45°C/km	5
A.4	Water & Gas chemistry	yes; part of the field is sour with H_2S	3
A.5	Mineral indicators and/or surface alteration	good information from well cuttings	5
A.6	Surface thermal features (type, temperature)	no surface features	0
A.7	Surface spring flow rates and Resource recharge	none known	0
A.8	3D permeability (heat exchange potential)	likely good permeability	5
A.9	Recent magmatism	sedimentary basin	0
A.10	Structural setting / seismic / tectonics	good knowledge of area due to drilling	5
A.11	Geophysics (type and interpretation if available)	a number of regional geophysical studies	3
A.12	Potential Resource host rocks	sedimentary sequence	5
A.13	Potential drilling issues	unlikely based on knowledge of the area	5
A.14	Brief description of geological setting of thermal features (i.e. springs emanate from fluvial gravels; beside a river; etc.)	reservoir is likely in gas bearing dolomite formation; heat flow is 45°C/km; but no reported aquifers shallower in the sequence.	3
B.	**Exploration Uncertainty (Risk)**		3.14
B.1	Degree of identification of resources/reserves	cooler < 80° C water is not reported above the 130-140° C waters in the gas bearing aquifer	3
B.2	Likelihood of covering Resource with concession	Given shallower target should not be conflict with oil and gas.	5
B.3	Expected authorization date	unknown	0
B.4	Specific timing of exploration (7 years BC)	exploration would be done Land Act permitting, 5 years for potential 5MW pilot plant (KWL report)	3
B.5	Degree of previous exploration (can be good or bad)	considerable knowledge from oil and gas exploration	4
B.6	Surface Operational capacity (enough stable area for drilling and facilities planned?)	good terrain; also road access	5
B.7	Exploration to exploitation (Difficult to easy)	high cost	2
C.	**Environmental Issues**		3.50
C.1	Protected areas (type and classification)	closest park is 40 km away	5
C.2	Endangered species	Boreal Mount Caribou; some birds and plants, 1 to 45 km from proposed resource area.	2
C.3	Geothermal surface features	none known. Nearest springs ~125 km away.	5
C.4	Other	transmission/piping route would cross many fish bearing streams.	2
D.	**Geothermal Area - Bidding and/or type of land holding (private/gov/lease/etc.)**		3.00
D.1	Bidding Area	No geothermal tracts. Permission to use Crown land is obtained by application under the Land Act (LA); target would be lower temperature < 80°C resource.	3
D.2	Electrical generation potential? Competition or collaboration possible from Companies present	yes, see KWL and Geothermex (2015)	3
D.3	Other claim rights(Mining and/or Oil)	oil and gas exploration in the area	3
E.	**Market**		1.00

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Jedney	
	Nearest community name:	Fort St. John	
	Nearest large community:	Prince George	
	Topographic map sheets (name and code) :	Medana Creek, 094G08	
	Geological map sheets (name and code)	94G.029	
E.1	Potential commodities for direct use applications	remote location along the Alaska Highway; locally collected wild foods (mushrooms); forest products.	1
E.2	Political stability and community relationship to development	no known issues; but limited population	1
E.3	Time Limits? (Business agreements, Operating/generating-by deadlines?)	no known issues; but limited population	2
E.4	Renewable energy "green value" for potential development	not part of a town planning process	0
F.	**Transmission Line Infrastructure**		0.50
F.1	State of the Infrastructure	If power is required for operation only available to Fox Creek substation	1
F.2	Transmission route (distance, terrain and costs)	remote area, >100 km of transmission required.	1
F.3	Wheeling power	n/a	0
F.4	Transmission providers	n/a	0
G.	**Laws governing direct-use renewable energy sources**		3.43
G.1	General Criteria of the Geothermal Law	important aspect is the temperature criteria; under 80 C Crown Land Tenure; above geothermal law.	3
G.2	General Criteria of the water resources law	need a water use licence	3
G.3	Direct sales possible	yes, with a licence	3
G.4	Carbon credits	BC Carbon Registry (new, in place 2016), Carbon Tax	4
G.5	Lease time and ability to renew or extend exploration licence	lease has been renewed once; could be done under crown land tenure	3
G.6	Issues (and timing) related to conversion from exploration to exploitation	If done under a geothermal lease specific work program is required.	3
G.7	Time frame for exploitation licence	Crown land tenure takes weeks to months, depending on the length of tenure requested; lease up to 30 years	5
H.	**Community Issues**		3.11
H.1	Indigenous Law and Indigenous Development Areas	Treaty 8 land area, most certainty about land claims and indigenous development processes.	5
H.2	Land claims	Treaty 8 land area	5
H.3	Community action	court challenge, demonstrations against Site C	3
H.4	Surface Rights	crown land grant	3
H.5	Visual considerations	logging and gas field development in the area	3
H.6	Tourism	no specific tourism site	0
H.7	Traditional use area: trapping, hunting, food and medicinal plants, fishing activities	see individual First nations: Blueberry River, Dene Tha', Doig River, Halfway River, Prophet River, west Moberly	3
H.8	Traditional use area: Community sacred site, gathering place or event sites	as above	3
H.9	Traditional use area: archeology sites and other areas of significance	as above	3
I.	**Water rights**		5.00
I.1	availability for proposed development	No nearby water licenses, >15 km is closest.	5
I.2	availability for drilling	yes, with a licence	5
J.	**Engineering**		2.00
J.1	Development proposal and design	no planning underway	0
J.2	Construction issues	none known; remote location; near highway	3
J.3	Transportation issues	long distances	1

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Jedney	
	Nearest community name:	Fort St. John	
	Nearest large community:	Prince George	
	Topographic map sheets (name and code) :	Medana Creek, 094G08	
	Geological map sheets (name and code)	94G.029	
J.4	Architectural Issues (blend/hide into environment? Local styles? Etc.)	none known	3
J.5	Special construction issues (heat exchanger & full injection)	none known	3
K.	**Non electrical infrastructure (roads and habitation)**		3.60
K.1	Nearest large community > 50,000	Prince George	3
K.2	nearest community and size	Fort St. John	2
K.3	Nearest road and condition	Alaska Highway, significant network of existing unpaved access roads.	5
K.4	Current access conditions (restrictions)	none known	5
K.5	Terrain and distance factor for road building	No requirement for new road anticipated.	3
L.	**Development Finance**		0.00
L.1	Development value (greenhouses; tourism; heating; etc.)		0
L.2	Market price for similar commodities not using direct-use heat		0
L.3	Green power premium for commodity?		0
L.4	Commodity price		0
L.5	Marketing implications		0
L.6	Estimated size of resource		0
L.7	Are there any green use incentives?		0
L.8	Grants		0
L.9	Tax holidays		0
L.10	Tax relief		0
L.11	Loan guarantees		0
L.12	Royalties/Fees		0
L.13	General idea of royalties		0
L.14	Private land owner or government land		0
L.15	Tax rate in the country		0
L.16	Transmission Tariffs		0
M.	**Maps**		5.00
M.1	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)		5
M.2	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks) (1:500,000?)		5
M.3	Regional geological map (1:250 or 500,000?)		5
M.4	Detailed geological map of the immediate area of the concessions (1:50,000 or 100,000)		5
N.	**Other issues and considerations**		0.00
N.1	Spatial concentration of potential customers	very limited population	0
N.2	Distance to market for prospective commodities	long distances	0
N.3	Costs to potential customers to receive Direct-use benefits	high on a per capita basis	0

OVERALL COMMENTS/ASSESSMENT	Very remote area with limited population base to build a development.

GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
AREA OF INTEREST:	King Island	
Nearest community name:	Bella Coola	
Nearest large community:	Williams Lake	
Topographic map sheets (name and code) :	Labouchere Channel, 093D06	
Geological map sheets (name and code)	93D.044	

King Island

A.	**Resource potential**		2.79
A.1	General geological setting	no clearly defined resource; scattered hot springs along large regional faults.	5
A.2	Size/potential/type	resource probably limited by fracture density	3
A.3	Temperature gradient/ Heat flow data	limited to spring T.	3
A.4	Water & Gas chemistry	neutral chemistry; sea water detected in some	3
A.5	Mineral indicators and/or surface alteration	limited	0
A.6	Surface thermal features (type, temperature)	temperatures up to ~45° C	5
A.7	Surface spring flow rates and Resource recharge	limited knowledge	2
A.8	3D permeability (heat exchange potential)	limited knowledge	2
A.9	Recent magmatism	mafic dykes of unknown, but geologically young ages.	3
A.10	Structural setting / seismic / tectonics	large scale, crustal features create fiords	5
A.11	Geophysics (type and interpretation if available)	regional geophysics available	1
A.12	Potential Resource host rocks	fracture permeability in rocks of mainly the coast plutonic complex.	3
A.13	Potential drilling issues	fracture and crystalline rocks	1
A.14	Brief description of geological setting of thermal features (i.e. springs emanate from fluvial gravels; beside a river; etc.)	a number of small springs along the inlets proximal to Bella Coola.	3
B.	**Exploration Uncertainty (Risk)**		2.43
B.1	Degree of identification of resources/reserves	along major fault structures, but no clearly defined resource	1
B.2	Likelihood of covering Resource with concession	no geothermal lease required; T below 80C	5
B.3	Expected authorization date	Current lodge for sale	3
B.4	Specific timing of exploration (7 years)	no geothermal lease required; T below 80C, once permits in place 5-6 years.	3
B.5	Degree of previous exploration (can be good or bad)	Lodge development that has changed hands	2
B.6	Surface Operational capacity (enough stable area for drilling and facilities planned?)	dependent on location	2
B.7	Exploration to exploitation (Difficult to easy)	challenging due to terrain and access	1
C.	**Environmental Issues**		2.00
C.1	Protected areas (type and classification)	local community plan to protect views; great Bear Rain forest and local conservancy areas	1
C.2	Endangered species	plant occurrences within proposed transmission/piping route.	3
C.3	Geothermal surface features	yes; used for First Nations and public	2
C.4	Other	developed spa currently for sale. Fish bearing streams along proposed transmission/piping route.	2
D.	**Geothermal Area - Bidding and/or type of land holding (private/gov/lease/etc.)**		2.33
D.1	Bidding Area	Permission to use Crown land is obtained by application under the Land Act (LA); target would be lower temperature < 80°C resource. Not known what existing lodge has for permits.	3
D.2	Electrical generation potential? Competition or collaboration possible from Companies present	possible but challenging	1
D.3	Other claim rights(Mining and/or Oil)	none known	3
E.	**Market**		2.75

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	King Island	
	Nearest community name:	Bella Coola	
	Nearest large community:	Williams Lake	
	Topographic map sheets (name and code) :	Labouchere Channel, 093D06	
	Geological map sheets (name and code)	93D.044	
E.1	Potential commodities for direct use applications	spa/resort potential	3
E.2	Political stability and community relationship to development	favourable to development that doesn't impact natural setting.	5
E.3	Time Limits? (Business agreements, Operating/generating-by deadlines?)	Current lodge for sale	3
E.4	Renewable energy "green value" for potential development	n/a	0
F.	**Transmission Line Infrastructure**		0.50
F.1	State of the Infrastructure	Bella Coola is off the grid (25 kV distribution system)	1
F.2	Transmission route (distance, terrain and costs)	Remote, >50 km of transmission line to Bella Coola.	1
F.3	Wheeling power	n/a	0
F.4	Transmission providers	n/a	0
G.	**Laws governing direct-use renewable energy sources**		3.43
G.1	General Criteria of the Geothermal Law	important aspect is the temperature criteria; under 80 C Crown Land Tenure; above geothermal law; existing commercial structure	3
G.2	General Criteria of the water resources law	need a water use licence	3
G.3	Direct sales possible	yes, with a licence	3
G.4	Carbon credits	BC Carbon Registry (new, in place 2016), Carbon Tax	4
G.5	Lease time and ability to renew or extend exploration licence	existing lodge at Nascall Hot Springs	3
G.6	Issues (and timing) related to conversion from exploration to exploitation	Geothermal lease not necessary	3
G.7	Time frame for exploitation licence	Crown land tenure takes weeks to months, depending on the length of tenure requested; lease up to 30 years; not known what existing lodge has for permits.	5
H.	**Community Issues**		2.67
H.1	Indigenous Law and Indigenous Development Areas	Heiltsuk BCTC stage 4; Heiltsuk have an economic development corp.	1
H.2	Land claims	Naxalk not in negotiation but asserts territory	1
H.3	Community action	stand against Enbridge; agreement reached to protect great bear rainforest; protested against fish farming; Bella Coola as a food action plan; Bella Coola has a community Plan (1998) key is protection of the natural setting	3
H.4	Surface Rights	treaty rights and crown land	3
H.5	Visual considerations	logging	3
H.6	Tourism	recreation destination	4
H.7	Traditional use area: trapping, hunting, food and medicinal plants, fishing activities	hot springs used for healing purposes	3
H.8	Traditional use area: Community sacred site, gathering place or event sites	Heiltsuk and Naxalk First Nations	3
H.9	Traditional use area: archeology sites and other areas of significance	Heiltsuk and Naxalk First Nations	3
I.	**Water rights**		5.00
I.1	availability for proposed development	3 active applications for water licenses nearby.	5
I.2	availability for drilling	yes, with a licence	5

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	King Island	
	Nearest community name:	Bella Coola	
	Nearest large community:	Williams Lake	
	Topographic map sheets (name and code) :	Labouchere Channel, 093D06	
	Geological map sheets (name and code)	93D.044	
J.	**Engineering**		2.60
J.1	Development proposal and design	existing lodge at Nascall Hot Springs	3
J.2	Construction issues	Springs are along waterways; spa/swimming facilities would be by boat/barge; existing lodge	5
J.3	Transportation issues	long distances; water access or float plan (Cruise ships)	1
J.4	Architectural Issues (blend/hide into environment? Local styles? Etc.)	needs to blend with natural environment	2
J.5	Special construction issues (heat exchanger & full injection)	materials would be required to be brought in by barge	2
K.	**Non electrical infrastructure (roads and habitation)**		0.40
K.1	Nearest large community > 50,000	Prince George	1
K.2	nearest community and size	Bella Coola (1910 in 2011)	1
K.3	Nearest road and condition	access is by boat or float plane	0
K.4	Current access conditions (restrictions)	limited access; remote region	0
K.5	Terrain and distance factor for road building	very difficult - barge access for building	0
L.	**Development Finance**		0.00
L.1	Development value (greenhouses; tourism; heating; etc.)		0
L.2	Market price for similar commodities not using direct-use heat		0
L.3	Green power premium for commodity?		0
L.4	Commodity price		0
L.5	Marketing implications		0
L.6	Estimated size of resource		0
L.7	Are there any green use incentives?		0
L.8	Grants		0
L.9	Tax holidays		0
L.10	Tax relief		0
L.11	Loan guarantees		0
L.12	Royalties/Fees		0
L.13	General idea of royalties		0
L.14	Private land owner or government land		0
L.15	Tax rate in the country		0
L.16	Transmission Tariffs		0
M.	**Maps**		5.00
M.1	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)		5
M.2	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks) (1:500,000?)		5
M.3	Regional geological map (1:250 or 500,000?)		5
M.4	Detailed geological map of the immediate area of the concessions (1:50,000 or 100,000)		5
N.	**Other issues and considerations**		1.33
N.1	Spatial concentration of potential customers	very low density of people; tourist appeal; needs marketing and plan to get people to the site.	4

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	King Island	
	Nearest community name:	Bella Coola	
	Nearest large community:	Williams Lake	
	Topographic map sheets (name and code) :	Labouchere Channel, 093D06	
	Geological map sheets (name and code)	93D.044	
N.2	Distance to market for prospective commodities	difficult access due to water/rugged mountains	0
N.3	Costs to potential customers to receive Direct-use benefits	very high	0

OVERALL COMMENTS/ASSESSMENT	Local use would be challenging due to lack of population and water only access. One functioning resort, Nascall is now closed. Potential for increased tourist trade and development. The property is still for sale http://www.oceanfront4sale.net/oceanfront-4-sale/canada-nascall-hotsprings-property-in-central-coast-british-columbia

GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
AREA OF INTEREST:	Kootenay	
Nearest community name:	Ainsworth Hot Springs	
Nearest large community:	Kelowna	
Topographic map sheets (name and code) :	Crawford Bay, 082F10	
Geological map sheets (name and code)	82F.076	

Kootenay

A.	**Resource potential**		3.93
A.1	General geological setting	well known	5
A.2	Size/potential/type	not defined, estimated 2 - 10 km3 using assumptions, depth to resource >500 m	5
A.3	Temperature gradient/ Heat flow data	34C/km along Purcell Trench	5
A.4	Water & Gas chemistry	Geothermometry indicate source temps up to 160C. Ainsworth alkalinity 1050 mg/L, Cl 45 mg/L; Riondel supersaturated with CO2, Dewar HCO3 149 mg/L, Mg 0.3 mg/L, Cl 54 mg/L.	4
A.5	Mineral indicators and/or surface alteration	limited	1
A.6	Surface thermal features (type, temperature)	Ainsworth springs nearby (48C). Also in the area: Riondel (48C), Dewar Creek (83C), Crawford Creek (30-32C) hot springs.	5
A.7	Surface spring flow rates and Resource recharge	Ainsworth 7L/s, Riondel potential up to 150 L/s, Dewar Creek, Crawford Creek, unknown.	4
A.8	3D permeability (heat exchange potential)		5
A.9	Recent magmatism		0
A.10	Structural setting / seismic / tectonics	Lots of evidence of fracturing/faulting	5
A.11	Geophysics (type and interpretation if available)	no information?	3
A.12	Potential Resource host rocks	Likely from fractured/faulted granitic/metamorphic rocks.	5
A.13	Potential drilling issues	Riondel: Scale buildup and high CO2 content	3
A.14	Brief description of geological setting of thermal features (i.e. springs emanate from fluvial gravels; beside a river; etc.)	deep circulation of fluids rising to the surface through fault systems	5
B.	**Exploration Uncertainty (Risk)**		2.57
B.1	Degree of identification of resources/reserves	Largely based on info from Riondel mine. Ainsworth hot springs confirm resource potential	3
B.2	Likelihood of covering Resource with concession	Ainsworth is commercial spa. Mineral tracts along west Kootenay Lake. Dewar Creek within Purcell Wilderness Conservancy Provincial Park. Riondel possible. Crawford Creek mineral title tracts surround on 3 sides.	3
B.3	Expected authorization date	No geothermal tracts nearby. Permission to use Crown land is obtained by application under the Land Act (LA); target would be lower temperature < 80°C resource.	0
B.4	Specific timing of exploration (2 + 2 years, BC 8 years, etc.)	as soon as permits can be put in place, 5-7 yr.	3
B.5	Degree of previous exploration (can be good or bad)	Geoscientific information exists. Geothermometry studies exist. Some temperature gradient knowledge but further definition required.	3
B.6	Surface Operational capacity (enough stable area for drilling and facilities planned?)	enough area needed appears sufficient.	5
B.7	Exploration to exploitation (Difficult to easy)	potential for water-use issues with mine leases/conservancy areas/hot spring resort nearby.	1
C.	**Environmental Issues**		2.00
C.1	Protected areas (type and classification)	Kokanee Lake Provincial Park <500 m from potential proposed transmission line. Cody Caves Provincial park <5 km away.	1
C.2	Endangered species	Blunt-sepaled starwort occurrence 5 km away; White Sturgeon <5 km, Westslope Cutthroat Trout.	2

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Kootenay	
	Nearest community name:	Ainsworth Hot Springs	
	Nearest large community:	Kelowna	
	Topographic map sheets (name and code) :	Crawford Bay, 082F10	
	Geological map sheets (name and code)	82F.076	
C.3	Geothermal surface features	Ainsworth hot springs resort nearby, Riondel hot springs ~7 km away.	3
C.4	Other	fish bearing stream nearby	2
D.	**Geothermal Area - Bidding and/or type of land holding (private/gov/lease/etc.)**		3.00
D.1	Bidding Area	No geothermal tracts nearby. Permission to use Crown land is obtained by application under the Land Act (LA); target would be lower temperature < 80°C resource.	3
D.2	Electrical generation potential? Competition or collaboration possible from Companies present	Ainsworth could be collaborative/competitive. See KWL report for electrical generation potential.	3
D.3	Other claim rights(Mining and/or Oil)	existing mineral, coal titles at resource area and within 30 km radius.	3
E.	**Market**		3.25
E.1	Potential commodities for direct use applications	Limited nearby populations: closest communities Balfour, Kaslo BC (<1000 pop). Greenhouses, mushroom drying forest products.	2
E.2	Political stability and community relationship to development	Ainsworth resort area already exists, so open to direct-use applications but may be competitive rather than collaborative.	3
E.3	Time Limits? (Business agreements, Operating/generating-by deadlines?)	none known	3
E.4	Renewable energy "green value" for potential development	Nearby communities favorable to green development.	5
F.	**Transmission Line Infrastructure**		2.50
F.1	State of the Infrastructure	closest substation 63 kV, 7 km away, existing roads.	5
F.2	Transmission route (distance, terrain and costs)	approx. 7 km transmission/piping required to closest substation along established powerline corridor.	5
F.3	Wheeling power	n/a	0
F.4	Transmission providers	n/a	0
G.	**Laws governing direct-use renewable energy sources**		3.43
G.1	General Criteria of the Geothermal Law	important aspect is the temperature criteria; under 80 C Crown Land Tenure; above geothermal law.	3
G.2	General Criteria of the water resources law	need a water use licence	3
G.3	Direct sales possible	yes, with a licence	3
G.4	Carbon credits	BC Carbon Registry (new, in place 2016), Carbon Tax	4
G.5	Lease time and ability to renew or extend exploration licence	could be done under geothermal/Land Act tenure.	3
G.6	Issues (and timing) related to conversion from exploration to exploitation	If done under a geothermal lease specific work program is required.	3
G.7	Time frame for exploitation licence	Crown land tenure takes weeks to months, depending on the length of tenure requested; lease up to 30 years	5
H.	**Community Issues**		2.78
H.1	Indigenous Law and Indigenous Development Areas	BC Treaty stage 4 and non-treaty First Nations	1
H.2	Land claims	Ktunaxa Nation Council, Okanagan Nation Alliance, Secwepemc Nation	1
H.3	Community action	Lower Kootenay Band purchasing Ainsworth hot spring near Kaslo, BC.	3

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Kootenay	
	Nearest community name:	Ainsworth Hot Springs	
	Nearest large community:	Kelowna	
	Topographic map sheets (name and code) :	Crawford Bay, 082F10	
	Geological map sheets (name and code)	82F.076	
H.4	Surface Rights	treaty and crown land	3
H.5	Visual considerations	hydro-electric, logging areas nearby.	4
H.6	Tourism	Existing extensive outdoor recreation tourism industry including camping, hiking, skiing, hot springs.	4
H.7	Traditional use area: trapping, hunting, food and medicinal plants, fishing activities	Ktunaxa Nation Council, Okanagan Nation Alliance, Secwepemc Nation	3
H.8	Traditional use area: Community sacred site, gathering place or event sites	Ktunaxa Nation Council, Okanagan Nation Alliance, Secwepemc Nation	3
H.9	Traditional use area: archeology sites and other areas of significance	Ktunaxa Nation Council, Okanagan Nation Alliance, Secwepemc Nation	3
I.	**Water rights**		4.00
I.1	availability for proposed development	70 water licences within 5 km of potential resource area (domestic and mineral trading).	3
I.2	availability for drilling	yes, with a licence	5
J.	**Engineering**		2.80
J.1	Development proposal and design	no planning underway	0
J.2	Construction issues	moderately sloped terrain	3
J.3	Transportation issues	Existing paved road <1 km from potential resource area.	5
J.4	Architectural Issues (blend/hide into environment? Local styles? Etc.)	none known	3
J.5	Special construction issues (heat exchanger & full injection)	none known	3
K.	**Non electrical infrastructure (roads and habitation)**		4.40
K.1	Nearest large community > 50,000	Kelowna	4
K.2	nearest community and size	Ainsworth, Balfour, Kaslo (all <1000 pop)	3
K.3	Nearest road and condition	paved road	5
K.4	Current access conditions (restrictions)	paved roads, small towns nearby for staff	5
K.5	Terrain and distance factor for road building	no requirements for new roads	5
L.	**Development Finance**		0.00
L.1	Development value (greenhouses; tourism; heating; etc.)		0
L.2	Market price for similar commodities not using direct-use heat		0
L.3	Green power premium for commodity?		0
L.4	Commodity price		0
L.5	Marketing implications		0
L.6	Estimated size of resource		0
L.7	Are there any green use incentives?		0
L.8	Grants		0
L.9	Tax holidays		0
L.10	Tax relief		0
L.11	Loan guarantees		0
L.12	Royalties/Fees		0
L.13	General idea of royalties		0
L.14	Private land owner or government land		0
L.15	Tax rate in the country		0
L.16	Transmission Tariffs		0

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Kootenay	
	Nearest community name:	Ainsworth Hot Springs	
	Nearest large community:	Kelowna	
	Topographic map sheets (name and code) :	Crawford Bay, 082F10	
	Geological map sheets (name and code)	82F.076	
M.	**Maps**		5.00
M.1	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)		5
M.2	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks) (1:500,000?)		5
M.3	Regional geological map (1:250 or 500,000?)		5
M.4	Detailed geological map of the immediate area of the concessions (1:50,000 or 100,000)		5
N.	**Other issues and considerations**		2.67
N.1	Spatial concentration of potential customers	Ainsworth, Balfour, Kaslo (all <1000 pop). Resort townsite nearby may indicate openness for more development or collaboration opportunities for direct use.	4
N.2	Distance to market for prospective commodities	Kelowna	3
N.3	Costs to potential customers to receive Direct-use benefits	moderate; limited local population	1

OVERALL COMMENTS/ASSESSMENT	Ainsworth townsite may be open to collaboration of another development, or additional direct-use applications.

GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
AREA OF INTEREST:	Lakelse Lake	
Nearest community name:	Terrace	
Nearest large community:	Prince George	
Topographic map sheets (name and code) :	Lakelse Lake, 103I07	
Geological map sheets (name and code)	103I.038	

Lakelse Lake

A.	**Resource potential**		4.29
A.1	General geological setting	likely a graben structure in the coast plutonic complex	5
A.2	Size/potential/type	large capacity; 457 liters/minute (MEM 2015)	5
A.3	Temperature gradient/ Heat flow data	Nine springs with a average T of 85 C; wells for pool facilities	5
A.4	Water & Gas chemistry	yes; geochemistry suggests 85°C	5
A.5	Mineral indicators and/or surface alteration	Surface manifestations, but little alteration	3
A.6	Surface thermal features (type, temperature)	Nine springs with a average T of 85 C; wells for pool facilities	5
A.7	Surface spring flow rates and Resource recharge	Flow rates up to 457 liters/minute	5
A.8	3D permeability (heat exchange potential)	little is known; likely fracture permeability	3
A.9	Recent magmatism	shallow pluton; young volcanism to the North.	3
A.10	Structural setting / seismic / tectonics	graben structure; faulting	5
A.11	Geophysics (type and interpretation if available)	regional gravity; EM conducted in 1984	5
A.12	Potential Resource host rocks	Coast plutonic complex	3
A.13	Potential drilling issues	private land	3
A.14	Brief description of geological setting of thermal features (i.e. springs emanate from fluvial gravels; beside a river; etc.)	major, crustal structure/lineament	5
B.	**Exploration Uncertainty (Risk)**		3.14
B.1	Degree of identification of resources/reserves	work underway by Borealis; assume they will define a reservoir and drilling targets.	4
B.2	Likelihood of covering Resource with concession	main springs are on private land; provincial parks and protected areas nearby.	2
B.3	Expected authorization date	Lease acquired 2014 - have 7 years to carry out work (yearly fee payment required or work); web site give 2017 as year of construction of power plant; no 2015 update	3
B.4	Specific timing of exploration (7 years)	Work underway by Borealis; no 2015 update. http://borealisgeopower.com/projects/lakelse-geothermal-kitselas-borealis-geopower/	3
B.5	Degree of previous exploration (can be good or bad)	private land has a resort complex currently closed	3
B.6	Surface Operational capacity (enough stable area for drilling and facilities planned?)	Enough area, may need to purchase private land.	4
B.7	Exploration to exploitation (Difficult to easy)	heavily treed area with private land	3
C.	Environmental Issues		2.50
C.1	Protected areas (type and classification)	Lakelse Provincial Park and private land	2
C.2	Endangered species	Bog Rush and White Adder's-mouth orchid	3
C.3	Geothermal surface features	springs used by locals; main springs are part of a closed resort.	3
C.4	Other	Resort is in a very run down state, significant modifications and upgrades would be needed to have it function. 12 Fish bearing streams on route of proposed transmission/piping line.	2
D.	Geothermal Area - Bidding and/or type of land holding (private/gov/lease/etc.)		2.67

APPENDIX D: Geothermal Development Decision Matrix (GDDM) summary and resource areas

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Lakelse Lake	
	Nearest community name:	Terrace	
	Nearest large community:	Prince George	
	Topographic map sheets (name and code) :	Lakelse Lake, 103I07	
	Geological map sheets (name and code)	103I.038	
D.1	Bidding Area	current geothermal lease; no mention of direct use on webpage, but local First Nations have identified the potential. Permission to use Crown land is obtained by application under the Land Act (LA); target would be lower temperature < 80°C resource.	3
D.2	Electrical generation potential? Competition or collaboration possible from Companies present	yes; lease held by Borealis Geothermal; likely will be payout	3
D.3	Other claim rights(Mining and/or Oil)	none known; private land	2
E.	**Market**		3.75
E.1	Potential commodities for direct use applications	fish, fish products, forestry, greenhouses; existing hot spring resort now closed.	4
E.2	Political stability and community relationship to development	good working relationship between most tribes and developers; agreements have been reached.	3
E.3	Time Limits? (Business agreements, Operating/generating-by deadlines?)	none known	3
E.4	Renewable energy "green value" for potential development	Terrace is open to green developments and has GHGE targets	5
F.	**Transmission Line Infrastructure**		1.00
F.1	State of the Infrastructure	existing 287 kV line but connection is 20 km away via existing transmission corridor; good paved road to area	2
F.2	Transmission route (distance, terrain and costs)	probably sufficient for small industrial applications from existing infrastructure.	2
F.3	Wheeling power	n/a	0
F.4	Transmission providers	n/a	0
G.	**Laws governing direct-use renewable energy sources**		3.43
G.1	General Criteria of the Geothermal Law	important aspect is the temperature criteria; under 80 C Crown Land Tenure; above geothermal law; existing commercial structure	3
G.2	General Criteria of the water resources law	need a water use licence	3
G.3	Direct sales possible	yes, with a licence	3
G.4	Carbon credits	BC Carbon Registry (new, in place 2016), Carbon Tax	4
G.5	Lease time and ability to renew or extend exploration licence	existing lease held by Borealis (January 21, 2014)	3
G.6	Issues (and timing) related to conversion from exploration to exploitation	Geothermal lease not necessary; would need to negotiate with lease holder	3
G.7	Time frame for exploitation licence	Crown land tenure takes weeks to months, depending on the length of tenure requested; lease up to 30 years; not known what existing lodge has for permits.	5
H.	**Community Issues**		2.56
H.1	Indigenous Law and Indigenous Development Areas	Kitselas; Kisumkalum; Lax Kw'alaams; Tsimshian are in negotiation stages 2 to 4.	1
H.2	Land claims	various stages of negotiations	1

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Lakelse Lake	
	Nearest community name:	Terrace	
	Nearest large community:	Prince George	
	Topographic map sheets (name and code) :	Lakelse Lake, 103I07	
	Geological map sheets (name and code)	103I.038	
H.3	Community action	Kitselas signed agreement with Borealis; Sustainable development is a stated objective; The City of Terrace has set the following GHG reduction targets: 5% below 2007 levels by 2015 11% below 2007 levels by 2020 80% below 2007 levels by 2050	5
H.4	Surface Rights	land claims; private land; crown land	1
H.5	Visual considerations	valley, logging, other industrial activity	3
H.6	Tourism	yes	3
H.7	Traditional use area: trapping, hunting, food and medicinal plants, fishing activities	Kitselas; Kisumkalum; Lax Kw'alaams; Metlakatla; Terrace; check out websites	3
H.8	Traditional use area: Community sacred site, gathering place or event sites	as above	3
H.9	Traditional use area: archeology sites and other areas of significance	as above	3
I.	**Water rights**		5.00
I.1	availability for proposed development	No nearby water licenses. More than 50 water licenses on east side of Lakelse Lake for domestic purpose.	5
I.2	availability for drilling	yes, with a licence	5
J.	**Engineering**		3.00
J.1	Development proposal and design	Borealis is working on electrical generation project, no mention of direct use applications http://borealisgeopower.com/projects/lakelse-geothermal-kitselas-borealis-geopower/	3
J.2	Construction issues	none reported	3
J.3	Transportation issues	none reported	3
J.4	Architectural Issues (blend/hide into environment? Local styles? Etc.)	none reported	3
J.5	Special construction issues (heat exchanger & full injection)	none reported	3
K.	**Non electrical infrastructure (roads and habitation)**		5.00
K.1	Nearest large community > 50,000	Prince George	5
K.2	nearest community and size	Terrace (11,230 in 2015)	5
K.3	Nearest road and condition	paved highway to Kitimat and transportation hub between Prince Rupert and Prince George.	5
K.4	Current access conditions (restrictions)	springs are on private land	5
K.5	Terrain and distance factor for road building	relatively easy terrain.	5
L.	**Development Finance**		0.00
L.1	Development value (greenhouses; tourism; heating; etc.)		0
L.2	Market price for similar commodities not using direct-use heat		0
L.3	Green power premium for commodity?		0
L.4	Commodity price		0
L.5	Marketing implications		0
L.6	Estimated size of resource		0
L.7	Are there any green use incentives?		0
L.8	Grants		0

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Lakelse Lake	
	Nearest community name:	Terrace	
	Nearest large community:	Prince George	
	Topographic map sheets (name and code) :	Lakelse Lake, 103I07	
	Geological map sheets (name and code)	103I.038	
L.9	Tax holidays		0
L.10	Tax relief		0
L.11	Loan guarantees		0
L.12	Royalties/Fees		0
L.13	General idea of royalties		0
L.14	Private land owner or government land		0
L.15	Tax rate in the country		0
L.16	Transmission Tariffs		0
M.	**Maps**		5.00
M.1	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)		5
M.2	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks) (1:500,000?)		5
M.3	Regional geological map (1:250 or 500,000?)		5
M.4	Detailed geological map of the immediate area of the concessions (1:50,000 or 100,000)		5
N.	**Other issues and considerations**		5.00
N.1	Spatial concentration of potential customers	Terrace has a significant eco-tourist trade	5
N.2	Distance to market for prospective commodities	close by rail; Kitimat and Prince Rupert major deep water ports	5
N.3	Costs to potential customers to receive Direct-use benefits	population of greater Terrace is around 19,000	5

OVERALL COMMENTS/ASSESSMENT	Electrical generation project underway; could enter into discussions as to other uses for the warm water. Borealis has discussed direct-use application with Valemount in their project there.

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Lower Arrow Lake	
	Nearest community name:	Fauquier	
	Nearest large community:	Kelowna	
	Topographic map sheets (name and code) :	Burrell Creek, 082E09	
	Geological map sheets (name and code)	82E.080	

Lower Arrow Lake

A.	**Resource potential**		3.00
A.1	General geological setting	well known	5
A.2	Size/potential/type	not defined but estimated at 5 km3, low temperature	1
A.3	Temperature gradient/ Heat flow data	regional heat flow calculated at 4.8 µW/m3	5
A.4	Water & Gas chemistry	Octopus Creek Cl 44 mg/L, geothermometry temp 87C	5
A.5	Mineral indicators and/or surface alteration		3
A.6	Surface thermal features (type, temperature)	Octopus Creek 49C, other cold springs	5
A.7	Surface spring flow rates and Resource recharge	low flow rates	3
A.8	3D permeability (heat exchange potential)	fractured rocks but may require reservoir stimulation.	2
A.9	Recent magmatism	no	0
A.10	Structural setting / seismic / tectonics	Lots of evidence of fracturing/faulting and intense folding	5
A.11	Geophysics (type and interpretation if available)	regional	1
A.12	Potential Resource host rocks	unknown, area by Octopus Creek is regionally granitic and other intrusive suites.	2
A.13	Potential drilling issues	possible hot dry rock project	0
A.14	Brief description of geological setting of thermal features (i.e. springs emanate from fluvial gravels; beside a river; etc.)	Intrusions are source of radiogenic heat.	5
B.	**Exploration Uncertainty (Risk)**		2.43
B.1	Degree of identification of resources/reserves	no reservoir yet identified	1
B.2	Likelihood of covering Resource with concession	Likely possible.	4
B.3	Expected authorization date	No geothermal tracts nearby. Permission to use Crown land is obtained by application under the Land Act (LA); target would be lower temperature < 80°C resource.	0
B.4	Specific timing of exploration (2 + 2 years, BC 8 years, etc.)	as soon as permits can be put in place, 5-7 year timeframe.	3
B.5	Degree of previous exploration (can be good or bad)	Geoscientific information exists. Geothermometry studies exist. Some temperature gradient knowledge but further definition required.	3
B.6	Surface Operational capacity (enough stable area for drilling and facilities planned?)	Likely.	5
B.7	Exploration to exploitation (Difficult to easy)	remote	1
C.	**Environmental Issues**		3.25
C.1	Protected areas (type and classification)	Arrow Lakes Provincial Park approx. 8 km away.	3
C.2	Endangered species	Three-leaved Lewisia (40 km away)	4
C.3	Geothermal surface features	Octopus Creek hot springs located ~1-2 km (but not really used) from potential resource area.	3
C.4	Other	No known fish-bearing streams in immediate vicinity; transmission would cross streams	3
D.	**Geothermal Area - Bidding and/or type of land holding (private/gov/lease/etc.)**		3.67
D.1	Bidding Area	No geothermal tracts nearby. Permission to use Crown land is obtained by application under the Land Act (LA); target would be lower temperature < 80°C resource.	3
D.2	Electrical generation potential? Competition or collaboration possible from Companies present	KWL report	3
D.3	Other claim rights(Mining and/or Oil)	no known coal/mineral/crown lease tenures nearby	5

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Lower Arrow Lake	
	Nearest community name:	Fauquier	
	Nearest large community:	Kelowna	
	Topographic map sheets (name and code) :	Burrell Creek, 082E09	
	Geological map sheets (name and code)	82E.080	
E.	**Market**		1.75
E.1	Potential commodities for direct use applications	forest based products, mushrooms drying, greenhouse; logging; although limited nearby community Fauquier (pop 200)	2
E.2	Political stability and community relationship to development	stable, but development favourability unknown	2
E.3	Time Limits? (Business agreements, Operating/generating-by deadlines?)	none known	3
E.4	Renewable energy "green value" for potential development	n/a	0
F.	**Transmission Line Infrastructure**		1.75
F.1	State of the Infrastructure	closest substation 500 kV and 138 kV, ~ 4 km away	5
F.2	Transmission route (distance, terrain and costs)	6 km of transmission/piping via existing unpaved roads. New substation will be required.	2
F.3	Wheeling power	n/a	0
F.4	Transmission providers	n/a	0
G.	**Laws governing direct-use renewable energy sources**		3.43
G.1	General Criteria of the Geothermal Law	important aspect is the temperature criteria; under 80 C Crown Land Tenure; above geothermal law.	3
G.2	General Criteria of the water resources law	need a water use licence	3
G.3	Direct sales possible	yes, with a licence	3
G.4	Carbon credits	BC Carbon Registry (new, in place 2016), Carbon Tax	4
G.5	Lease time and ability to renew or extend exploration licence	could be done under geothermal/Land Act tenure.	3
G.6	Issues (and timing) related to conversion from exploration to exploitation	If done under a geothermal lease specific work program is required.	3
G.7	Time frame for exploitation licence	Crown land tenure takes weeks to months, depending on the length of tenure requested; lease up to 30 years	5
H.	**Community Issues**		2.44
H.1	Indigenous Law and Indigenous Development Areas	Ktunaxa Nation BCTC Stage 4	1
H.2	Land claims	Ktunaxa Nation Council, Sinixt Nation. Secwepemc and Westbank nearby (25-35 km away)	1
H.3	Community action	no significant population nearby (Fauquier pop 200)	2
H.4	Surface Rights	treaty and crown land	3
H.5	Visual considerations	logging areas and roads nearby	3
H.6	Tourism	Lower Arrow Lakes-Needle Ferry, outdoor recreation area. Most activities are centralized near Fauquier, BC.	3
H.7	Traditional use area: trapping, hunting, food and medicinal plants, fishing activities	Ktunaxa Nation Council, Okanagan Nation Alliance, Secwepemc Nation	3
H.8	Traditional use area: Community sacred site, gathering place or event sites	Ktunaxa Nation Council, Okanagan Nation Alliance, Secwepemc Nation	3
H.9	Traditional use area: archeology sites and other areas of significance	Ktunaxa Nation Council, Okanagan Nation Alliance, Secwepemc Nation	3
I.	**Water rights**		5.00
I.1	availability for proposed development	4 current water licenses within 5 km of potential resource area.	5
I.2	availability for drilling	yes, with a licence	5

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Lower Arrow Lake	
	Nearest community name:	Fauquier	
	Nearest large community:	Kelowna	
	Topographic map sheets (name and code) :	Burrell Creek, 082E09	
	Geological map sheets (name and code)	82E.080	
J.	**Engineering**		2.00
J.1	Development proposal and design	no planning underway	0
J.2	Construction issues	Remote, steep mountainous terrain, unpaved roads	1
J.3	Transportation issues	none known	3
J.4	Architectural Issues (blend/hide into environment? Local styles? Etc.)	none known	3
J.5	Special construction issues (heat exchanger & full injection)	none known	3
K.	**Non electrical infrastructure (roads and habitation)**		3.80
K.1	Nearest large community > 50,000	Kelowna	4
K.2	nearest community and size	Fauquier (pop 200)	2
K.3	Nearest road and condition	unpaved existing logging road	3
K.4	Current access conditions (restrictions)	unpaved road access to potential resource area.	5
K.5	Terrain and distance factor for road building	no requirements for new roads	5
L.	**Development Finance**		0.00
L.1	Development value (greenhouses; tourism; heating; etc.)		0
L.2	Market price for similar commodities not using direct-use heat		0
L.3	Green power premium for commodity?		0
L.4	Commodity price		0
L.5	Marketing implications		0
L.6	Estimated size of resource		0
L.7	Are there any green use incentives?		0
L.8	Grants		0
L.9	Tax holidays		0
L.10	Tax relief		0
L.11	Loan guarantees		0
L.12	Royalties/Fees		0
L.13	General idea of royalties		0
L.14	Private land owner or government land		0
L.15	Tax rate in the country		0
L.16	Transmission Tariffs		0
M.	**Maps**		5.00
M.1	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)		5
M.2	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks) (1:500,000?)		5
M.3	Regional geological map (1:250 or 500,000?)		5
M.4	Detailed geological map of the immediate area of the concessions (1:50,000 or 100,000)		5
N.	**Other issues and considerations**		1.67
N.1	Spatial concentration of potential customers	Fauquier (pop 200), limited small local community.	1
N.2	Distance to market for prospective commodities	Kelowna	3

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Lower Arrow Lake	
	Nearest community name:	Fauquier	
	Nearest large community:	Kelowna	
	Topographic map sheets (name and code) :	Burrell Creek, 082E09	
	Geological map sheets (name and code)	82E.080	
N.3	Costs to potential customers to receive Direct-use benefits	moderate to high; limited local population	1

OVERALL COMMENTS/ASSESSMENT	Potential for development but area is remote with minimal previous exploration of any type. Other nearby springs (Nakusp, Ainsworth, etc.) with high level of development would be competing.

GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
AREA OF INTEREST:	Meager-Pebble	
Nearest community name:	Pemberton	
Nearest large community:	North Vancouver	
Topographic map sheets (name and code) :	Chischa River/Akue Creek, 092J12/092J11	
Geological map sheets (name and code)	92J.053, 92J.063	

Meager-Pebble

A.	**Resource potential**		4.43
A.1	General geological setting	near a large strato volcano with recent eruptive history.	5
A.2	Size/potential/type	15 km3 (KWL & GT 2015) 100 -200 MW	5
A.3	Temperature gradient/ Heat flow data	high heat flows; T up to 270 at 1,200 m	5
A.4	Water & Gas chemistry	measured and calculated T up to 270	5
A.5	Mineral indicators and/or surface alteration	extensive surface alteration; lead to failure in Capricorn Creek, 2010	5
A.6	Surface thermal features (type, temperature)	multiple seeps and springs used for bathing	5
A.7	Surface spring flow rates and Resource recharge	Low flows from springs; meteoric recharge ~30 years	5
A.8	3D permeability (heat exchange potential)	low formation permeability; but potentially good fracture permeability	3
A.9	Recent magmatism	2350 yrBP explosive to passive dacite eruption	5
A.10	Structural setting / seismic / tectonics	young volcanism and faulting forming graben structure	5
A.11	Geophysics (type and interpretation if available)	MT shows strong anomaly	5
A.12	Potential Resource host rocks	Mesozoic aged quartz Diorite	3
A.13	Potential drilling issues	Hard and abrasive formation	3
A.14	Brief description of geological setting of thermal features (i.e. springs emanate from fluvial gravels; beside a river; etc.)	drilling and other work demonstrated heat but not permeability; fracture permeability needs to be carefully targeted.	3
B.	**Exploration Uncertainty (Risk)**		3.43
B.1	Degree of identification of resources/reserves	Still high risk until permeability it located and can be targeted.	3
B.2	Likelihood of covering Resource with concession	good	4
B.3	Expected authorization date	Permit in place. Lease to expire 2017	4
B.4	Specific timing of exploration (BC 7 years)	unknown; could be 3-5 years but company is no longer active in area. Can be done under Land Act.	4
B.5	Degree of previous exploration (can be good or bad)	significant exploration and drilling	4
B.6	Surface Operational capacity (enough stable area for drilling and facilities planned?)	steep terrain subject to landslides and snow avalanches.	2
B.7	Exploration to exploitation (Difficult to easy)	easy to moderate	3
C.	**Environmental Issues**		2.00
C.1	Protected areas (type and classification)	Upper Lillooet Prov. Park 2 km away;	1
C.2	Endangered species	Vivid Dancer dragon fly; spotted owl; plants	2
C.3	Geothermal surface features	prior to landslide were heavily used	3
C.4	Other	Grizzly and sheep habitat areas overlap active title tracts	2
D.	**Geothermal Area - Bidding and/or type of land holding (private/gov/lease/etc.)**		3.67
D.1	Bidding Area	Polaris infrastructure leases to expire in 2017. Permission to use Crown land is obtained by application under the Land Act (LA); target would be lower temperature < 80°C resource.	3
D.2	Electrical generation potential? Competition or collaboration possible from Companies present	high, see KWL & GeothermEx 2015 report	5
D.3	Other claim rights (Mining and/or Oil)	mineral/coal title north of Mt. Meager, minimal overlap with active geothermal tract; pumice was mined locally.	3
E.	**Market**		4.25
E.1	Potential commodities for direct use applications	mushroom drying; forest products	3

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Meager-Pebble	
	Nearest community name:	Pemberton	
	Nearest large community:	North Vancouver	
	Topographic map sheets (name and code) :	Chischa River/Akue Creek, 092J12/092J11	
	Geological map sheets (name and code)	92J.053, 92J.063	
E.2	Political stability and community relationship to development	positive relationship between local community and development; area currently under development for run of river hydro.	5
E.3	Time Limits? (Business agreements, Operating/generating-by deadlines?)	current geothermal lease expires in 2017, exploration has stalled but has potential due to hydro-electric project nearby	4
E.4	Renewable energy "green value" for potential development	Pemberton is favourable to green development	5
F.	**Transmission Line Infrastructure**		3.00
F.1	State of the Infrastructure	Transmission line with Energex project	4
F.2	Transmission route (distance, terrain and costs)	if capacity on Energex line 2-10 km to connection, need to go thru slide debris area for Meager	3
F.3	Wheeling power	n/a	0
F.4	Transmission providers	Innergex/BC Hydro	5
G.	**Laws governing direct-use renewable energy sources**		3.43
G.1	General Criteria of the Geothermal Law	important aspect is the temperature criteria; under 80 C Crown Land Tenure; above geothermal law.	3
G.2	General Criteria of the water resources law	need a water use licence	3
G.3	Direct sales possible	yes, with a licence	3
G.4	Carbon credits	BC Carbon Registry (new, in place 2016), Carbon Tax	4
G.5	Lease time and ability to renew or extend exploration licence	current geothermal lease expires in 2017	3
G.6	Issues (and timing) related to conversion from exploration to exploitation	If done under a geothermal lease specific work program is required.	3
G.7	Time frame for exploitation licence	Crown land tenure takes weeks to months, depending on the length of tenure requested; lease up to 30 years; Provincial Park	5
H.	**Community Issues**		2.67
H.1	Indigenous Law and Indigenous Development Areas	none currently in negotiation with BC Treaty Commission	1
H.2	Land claims	Lillooet, Mount Currie and St'at'imc not currently in negotiation; St'at'imc Land and Resources Authority - SLRA (www.statimc.net), within asserted area	1
H.3	Community action	objections to planned ski area development; St'at'imc signed BC Hydro agreement; large hydro project with Innergex close to geothermal, company statement as to close association with first nations.	3
H.4	Surface Rights	not currently in treaty negotiations	3
H.5	Visual considerations	Large hydro project nearby	4
H.6	Tourism	Before road wash out there was significant number of visitors to the hot springs.	3
H.7	Traditional use area: trapping, hunting, food and medicinal plants, fishing activities	St'at'imc traditional use area	3
H.8	Traditional use area: Community sacred site, gathering place or event sites	St'at'imc traditional use area	3
H.9	Traditional use area: archeology sites and other areas of significance	St'at'imc traditional use area	3
I.	**Water rights**		4.00

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Meager-Pebble	
	Nearest community name:	Pemberton	
	Nearest large community:	North Vancouver	
	Topographic map sheets (name and code) :	Chischa River/Akue Creek, 092J12/092J11	
	Geological map sheets (name and code)	92J.053, 92J.063	
I.1	availability for proposed development	No active water licenses within 5 km, but 6 km away for Boulder Creek hydro project. Need to consult Innergex developer.	3
I.2	availability for drilling	yes, with a licence	5
J.	**Engineering**		2.60
J.1	Development proposal and design	none identified	0
J.2	Construction issues	Innergex development nearby.	4
J.3	Transportation issues	gravel roads on east side recently upgraded; west side road still not completed.	3
J.4	Architectural Issues (blend/hide into environment? Local styles? Etc.)	none known	3
J.5	Special construction issues (heat exchanger & full injection)	none known	3
K.	**Non electrical infrastructure (roads and habitation)**		3.40
K.1	Nearest large community > 50,000	North Vancouver	4
K.2	nearest community and size	Pemberton pop 2,436 (2014)	2
K.3	Nearest road and condition	paved and unpaved road	3
K.4	Current access conditions (restrictions)	no restrictions	5
K.5	Terrain and distance factor for road building	rebuild road through Capricorn or on south side of Meager Creek.	3
L.	**Development Finance**		0.00
L.1	Development value (greenhouses; tourism; heating; etc.)		0
L.2	Market price for similar commodities not using direct-use heat		0
L.3	Green power premium for commodity?		0
L.4	Commodity price		0
L.5	Marketing implications		0
L.6	Estimated size of resource		0
L.7	Are there any green use incentives?		0
L.8	Grants		0
L.9	Tax holidays		0
L.10	Tax relief		0
L.11	Loan guarantees		0
L.12	Royalties/Fees		0
L.13	General idea of royalties		0
L.14	Private land owner or government land		0
L.15	Tax rate in the country		0
L.16	Transmission Tariffs		0
M.	**Maps**		5.00
M.1	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)		5
M.2	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks) (1:500,000?)		5
M.3	Regional geological map (1:250 or 500,000?)		5

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Meager-Pebble	
	Nearest community name:	Pemberton	
	Nearest large community:	North Vancouver	
	Topographic map sheets (name and code) :	Chischa River/Akue Creek, 092J12/092J11	
	Geological map sheets (name and code)	92J.053, 92J.063	
M.4	Detailed geological map of the immediate area of the concessions (1:50,000 or 100,000)		5
N.	**Other issues and considerations**		2.00
N.1	Spatial concentration of potential customers	Pemberton is a small community, major industry is tourism.	2
N.2	Distance to market for prospective commodities	Good highway access to Vancouver and other centres.	3
N.3	Costs to potential customers to receive Direct-use benefits	no subsidies	1

OVERALL COMMENTS/ASSESSMENT	Distance from Pemberton remains an issue. With new hydro project much more favourable for electrical generation. New road/access makes bathing/spa more likely, but travel distance is still significant. Upwards of 30,000 visitors/year were recorded prior to the destruction of the road by landslide.

GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
AREA OF INTEREST:	Mt. Cayley	
Nearest community name:	Squamish	
Nearest large community:	North Vancouver	
Topographic map sheets (name and code) :	Tenaka Creek, 092J03	
Geological map sheets (name and code)	92J.014	

Mt. Cayley

A.	**Resource potential**		4.21
A.1	General geological setting	young volcanism nearby and large structures	5
A.2	Size/potential/type	small to medium from electrical potential	5
A.3	Temperature gradient/ Heat flow data	some heat flow data show 33-59 C/km; hot springs give T up to 28C	5
A.4	Water & Gas chemistry	extensive alteration near volcanic center	5
A.5	Mineral indicators and/or surface alteration	yes	5
A.6	Surface thermal features (type, temperature)	two groups of small springs with low flow	5
A.7	Surface spring flow rates and Resource recharge	very low flow rate reported	3
A.8	3D permeability (heat exchange potential)	unknown reservoir	3
A.9	Recent magmatism	yes; youngest is just post glacial (<10k)	5
A.10	Structural setting / seismic / tectonics	young volcanism nearby and large structures	5
A.11	Geophysics (type and interpretation if available)	regional as well as DC and EM circa mid 1980's; deep seismic done in mid '90s identified a "bright spot".	5
A.12	Potential Resource host rocks	crystalline basement rocks	3
A.13	Potential drilling issues	access; landslide hazards	0
A.14	Brief description of geological setting of thermal features (i.e. springs emanate from fluvial gravels; beside a river; etc.)	springs are associated with young volcanism at Mt. Cayley; significant alteration has led to slope stability issues similar to Mt. Meager	5
B.	**Exploration Uncertainty (Risk)**		2.14
B.1	Degree of identification of resources/reserves	no reservoir has been identified	1
B.2	Likelihood of covering Resource with concession	geothermal concession, but no work for many years.	3
B.3	Expected authorization date	unknown reservoir	0
B.4	Specific timing of exploration	under Land Act tenure, 5-7 years.	3
B.5	Degree of previous exploration (can be good or bad)	some exploration	3
B.6	Surface Operational capacity (enough stable area for drilling and facilities planned?)	difficult in areas of springs but closer to river it is possible.	2
B.7	Exploration to exploitation (Difficult to easy)	good possibility of finding resource of <80C, but remote access	3
C.	**Environmental Issues**		3.00
C.1	Protected areas (type and classification)	many provincial parks in vicinity, but none very near potential resource site (6-25 km away). conservancy area close by	3
C.2	Endangered species	plants and amphibians possible, but not reported in vicinity.	3
C.3	Geothermal surface features	yes, but not used and extremely difficult to access.	4
C.4	Other	many river crossing with salmon	2
D.	**Geothermal Area - Bidding and/or type of land holding (private/gov/lease/etc.)**		3.00
D.1	Bidding Area	cancelled geothermal lease. Permission to use Crown land is obtained by application under the Land Act (LA); target would be lower temperature < 80°C resource.	3
D.2	Electrical generation potential? Competition or collaboration possible from Companies present	yes, geothermal exploration has been undertaken, no development underway. See KWL report	3
D.3	Other claim rights(Mining and/or Oil)	Mineral/coal titles southwest of potential resource area.	3
E.	**Market**		2.50
E.1	Potential commodities for direct use applications	local forest products (mushrooms, plants, fish and logging); no close population; remote and limited access.	3

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Mt. Cayley	
	Nearest community name:	Squamish	
	Nearest large community:	North Vancouver	
	Topographic map sheets (name and code) :	Tenaka Creek, 092J03	
	Geological map sheets (name and code)	92J.014	
E.2	Political stability and community relationship to development	First nations interest; Squamish is a long way away.	3
E.3	Time Limits? (Business agreements, Operating/generating-by deadlines?)	nothing planned	3
E.4	Renewable energy "green value" for potential development	Squamish is favourable to green development but high cost due to limited population in nearby vicinity.	1
F.	**Transmission Line Infrastructure**		0.50
F.1	State of the Infrastructure	closest transmission is 20 km east but very mountainous terrain	1
F.2	Transmission route (distance, terrain and costs)	new line within 20 km, but rugged mountainous terrain.	1
F.3	Wheeling power	n/a	0
F.4	Transmission providers	n/a	0
G.	**Laws governing direct-use renewable energy sources**		3.43
G.1	General Criteria of the Geothermal Law	important aspect is the temperature criteria; under 80 C Crown Land Tenure; above geothermal law.	3
G.2	General Criteria of the water resources law	need a water use licence	3
G.3	Direct sales possible	yes, with a licence	3
G.4	Carbon credits	BC Carbon Registry (new, in place 2016), Carbon Tax	4
G.5	Lease time and ability to renew or extend exploration licence	geothermal lease expired	3
G.6	Issues (and timing) related to conversion from exploration to exploitation	If done under a geothermal lease specific work program is required.	3
G.7	Time frame for exploitation licence	Crown land tenure takes weeks to months, depending on the length of tenure requested; lease up to 30 years; Provincial Park	5
H.	**Community Issues**		2.78
H.1	Indigenous Law and Indigenous Development Areas	Squamish Nation BC treaty negotiation Stage 3	1
H.2	Land claims	Stage 3 treaty negotiations	1
H.3	Community action	Squamish as a community plan with GHGE reduction target; road is the main access to the Elaho Valley wilderness area.	5
H.4	Surface Rights	crown land; conservancy area	3
H.5	Visual considerations	logging in valley	3
H.6	Tourism	very limited; remote area	3
H.7	Traditional use area: trapping, hunting, food and medicinal plants, fishing activities	2001 Squamish Nation developed stewardship plan http://www.squamish.net/about-us/our-land/xay-temixw-sacred-land-land-use-plan/	3
H.8	Traditional use area: Community sacred site, gathering place or event sites	as above	3
H.9	Traditional use area: archeology sites and other areas of significance	as above	3
I.	**Water rights**		5.00
I.1	availability for proposed development	only 1 existing water license within 10 km.	5
I.2	availability for drilling	yes, with a licence	5
J.	**Engineering**		1.60
J.1	Development proposal and design	no development proposed	0

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Mt. Cayley	
	Nearest community name:	Squamish	
	Nearest large community:	North Vancouver	
	Topographic map sheets (name and code) :	Tenaka Creek, 092J03	
	Geological map sheets (name and code)	92J.014	
J.2	Construction issues	steep terrain; gravel access road subject to washouts.	1
J.3	Transportation issues	gravel road not maintained in winter	1
J.4	Architectural Issues (blend/hide into environment? Local styles? Etc.)	none known	3
J.5	Special construction issues (heat exchanger & full injection)	none known	3
K.	**Non electrical infrastructure (roads and habitation)**		2.80
K.1	Nearest large community > 50,000	North Vancouver	5
K.2	nearest community and size	Squamish (Whistler is closer but over the mountains)	2
K.3	Nearest road and condition	gravel road not maintained in winter	1
K.4	Current access conditions (restrictions)	gravel road not maintained in winter	1
K.5	Terrain and distance factor for road building	no new roads required	5
L.	**Development Finance**		0.00
L.1	Development value (greenhouses; tourism; heating; etc.)		0
L.2	Market price for similar commodities not using direct-use heat		0
L.3	Green power premium for commodity?		0
L.4	Commodity price		0
L.5	Marketing implications		0
L.6	Estimated size of resource		0
L.7	Are there any green use incentives?		0
L.8	Grants		0
L.9	Tax holidays		0
L.10	Tax relief		0
L.11	Loan guarantees		0
L.12	Royalties/Fees		0
L.13	General idea of royalties		0
L.14	Private land owner or government land		0
L.15	Tax rate in the country		0
L.16	Transmission Tariffs		0
M.	**Maps**		5.00
M.1	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)		5
M.2	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks) (1:500,000?)		5
M.3	Regional geological map (1:250 or 500,000?)		5
M.4	Detailed geological map of the immediate area of the concessions (1:50,000 or 100,000)		5
N.	**Other issues and considerations**		1.33
N.1	Spatial concentration of potential customers	Squamish is a major tourist centre	2
N.2	Distance to market for prospective commodities	gravel road not maintained in winter	1
N.3	Costs to potential customers to receive Direct-use benefits	high due to distance from population	1

GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
AREA OF INTEREST:	Mt. Cayley	
Nearest community name:	Squamish	
Nearest large community:	North Vancouver	
Topographic map sheets (name and code) :	Tenaka Creek, 092J03	
Geological map sheets (name and code)	92J.014	
OVERALL COMMENTS/ASSESSMENT	Cayley is more than 40 km from Squamish on gravel road; there is limited winter access. For a spa or bathing facility significant marketing and transportation alternatives would need to developed. It is on a direct path to the Elaho valley and its giant Douglas fir trees. In 2015 a 600+ hectare fire threatened the Elaho giant, but it was saved. The road however, has become impassable due to washouts after the fire.	

GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
AREA OF INTEREST:	Mt. Garibaldi	
Nearest community name:	Squamish	
Nearest large community:	North Vancouver	
Topographic map sheets (name and code) :	Cheakamus River, 092G14	
Geological map sheets (name and code)	92G.085	

Mt. Garibaldi

A.	**Resource potential**		2.36
A.1	General geological setting	young volcanism nearby and large structures	5
A.2	Size/potential/type	no identified reservoir; rumours of warm springs and warm ground east of the volcano have never been verified; possibility of warm ground near Table Meadows (south of Mt Price) a post glacial strato volcano.	0
A.3	Temperature gradient/ Heat flow data	some heat flow data to the east near Mt. Cayley show 33-59 C/km; hot springs give T up to 28C	3
A.4	Water & Gas chemistry	none	0
A.5	Mineral indicators and/or surface alteration	none known; mercury and arsenic anomalies near Brohm Lake	3
A.6	Surface thermal features (type, temperature)	none known	0
A.7	Surface spring flow rates and Resource recharge	no surface springs	0
A.8	3D permeability (heat exchange potential)	unknown reservoir	3
A.9	Recent magmatism	yes; youngest is post glacial (<10k)	5
A.10	Structural setting / seismic / tectonics	young volcanism nearby and large structures	5
A.11	Geophysics (type and interpretation if available)	Seismic done in mid '90s identified a "bright spot" to the north.	5
A.12	Potential Resource host rocks	crystalline basement rocks	3
A.13	Potential drilling issues	access; landslide hazards (Cheekye Fan)	0
A.14	Brief description of geological setting of thermal features (i.e. springs emanate from fluvial gravels; beside a river; etc.)	young volcanic center with post glacial volcanism; significant alteration at head of Cheekye fan leads to major instability.	1
B.	**Exploration Uncertainty (Risk)**		0.86
B.1	Degree of identification of resources/reserves	no reservoir has been identified	1
B.2	Likelihood of covering Resource with concession	western slopes can be covered but Garibaldi Provincial park occupies most prospective ground.	0
B.3	Expected authorization date	unknown	0
B.4	Specific timing of exploration (2 + 2 years, BC 8 years, etc.)	depends if development possible outside of Park, 7yr	1
B.5	Degree of previous exploration (can be good or bad)	minimal, requires drilling for confirmation of resource	1
B.6	Surface Operational capacity (enough stable area for drilling and facilities planned?)	Potentially, but would require planning. western slopes are steep; Cheekye fan instability	2
B.7	Exploration to exploitation (Difficult to easy)	small probability of finding resource of <80C	1
C.	**Environmental Issues**		3.00
C.1	Protected areas (type and classification)	many provincial parks in vicinity, largest is Garibaldi Prov. Park (8 km), closest is Brackendale Eagles Prov. Park 2 km from potential transmission/piping route.	2
C.2	Endangered species	some plants (4-10 km away)	3
C.3	Geothermal surface features	none known. Nearest hot springs 48 km away.	5
C.4	Other	river crossings with salmon. Wildlife habitat area for Marbled Murrelet ~2 km from proposed resource area.	2
D.	**Geothermal Area - Bidding and/or type of land holding (private/gov/lease/etc.)**		3.00
D.1	Bidding Area	no existing geothermal tracts. Permission to use Crown land is obtained by application under the Land Act (LA); target would be lower temperature < 80°C resource.	3

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Mt. Garibaldi	
	Nearest community name:	Squamish	
	Nearest large community:	North Vancouver	
	Topographic map sheets (name and code) :	Cheakamus River, 092G14	
	Geological map sheets (name and code)	92G.085	
D.2	Electrical generation potential? Competition or collaboration possible from Companies present	yes, geothermal exploration has been undertaken, no development underway, but not favourable economics (see KWL report).	1
D.3	Other claim rights(Mining and/or Oil)	none known	5
E.	**Market**		4.00
E.1	Potential commodities for direct use applications	local forest products (mushrooms, plants, fish and logging); close population; good access.	5
E.2	Political stability and community relationship to development	First nations interest; highway is a major tourist corridor; Squamish is committed to preservation of outdoor recreation "Hard wired for Adventure"	3
E.3	Time Limits? (Business agreements, Operating/generating-by deadlines?)	nothing planned	3
E.4	Renewable energy "green value" for potential development	high; local community has been moving from resource based economy to tourism; "green value" in development.	5
F.	**Transmission Line Infrastructure**		1.50
F.1	State of the Infrastructure	500 and 300 kV with nearby substation, 5 km away but moderate to steep terrain	3
F.2	Transmission route (distance, terrain and costs)	depends on location and type of development; relatively short transmission	3
F.3	Wheeling power	n/a	0
F.4	Transmission providers	n/a	0
G.	**Laws governing direct-use renewable energy sources**		3.43
G.1	General Criteria of the Geothermal Law	important aspect is the temperature criteria; under 80 C Crown Land Tenure; above geothermal law.	3
G.2	General Criteria of the water resources law	need a water use licence	3
G.3	Direct sales possible	yes, with a licence	3
G.4	Carbon credits	BC Carbon Registry (new, in place 2016), Carbon Tax	4
G.5	Lease time and ability to renew or extend exploration licence	geothermal lease expired, could be done under land act tenure	3
G.6	Issues (and timing) related to conversion from exploration to exploitation	If done under a geothermal lease specific work program is required.	3
G.7	Time frame for exploitation licence	Crown land tenure takes weeks to months, depending on the length of tenure requested; lease up to 30 years; Provincial Park	5
H.	**Community Issues**		2.78
H.1	Indigenous Law and Indigenous Development Areas	Squamish nation in Stage 3 BC treaty negotiation	1
H.2	Land claims	Stage 3 treaty negotiations	1
H.3	Community action	Squamish as a community plan with GHGE reduction target; no mention of geothermal, but do have an energy action committee; BC Government funding in 2013 to assess renewal energy options https://news.gov.bc.ca/stories/clean-energy-opportunities-for-11-first-nations-communities. Squamish Nation; Lil'wat First Nations; have been looking into renewal energy options.	5
H.4	Surface Rights	crown land; provincial parks	3

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Mt. Garibaldi	
	Nearest community name:	Squamish	
	Nearest large community:	North Vancouver	
	Topographic map sheets (name and code) :	Cheakamus River, 092G14	
	Geological map sheets (name and code)	92G.085	
H.5	Visual considerations	logging in valley	3
H.6	Tourism	significant hiking, skiing, biking as well as along corridor to Whistler	3
H.7	Traditional use area: trapping, hunting, food and medicinal plants, fishing activities	2001 Squamish Nation developed stewardship plan http://www.squamish.net/about-us/our-land/xay-temixw-sacred-land-land-use-plan/	3
H.8	Traditional use area: Community sacred site, gathering place or event sites	as above	3
H.9	Traditional use area: archeology sites and other areas of significance	as above	3
I.	**Water rights**		5.00
I.1	availability for proposed development	2 current water licenses, 8 applications within 5 km.	5
I.2	availability for drilling	yes, with a licence	5
J.	**Engineering**		1.60
J.1	Development proposal and design	no development proposed	0
J.2	Construction issues	steep terrain; gravel access road subject to washouts.	1
J.3	Transportation issues	main highway; fully maintained year round; subsidiary roads are not maintained.	1
J.4	Architectural Issues (blend/hide into environment? Local styles? Etc.)	none known; but visual considerations would be important	3
J.5	Special construction issues (heat exchanger & full injection)	none known; but would need to fit into natural setting of area and tourist values.	3
K.	**Non electrical infrastructure (roads and habitation)**		4.00
K.1	Nearest large community > 50,000	North Vancouver	5
K.2	nearest community and size	Squamish population 17,158 (2011)	2
K.3	Nearest road and condition	main highway; fully maintained year round	5
K.4	Current access conditions (restrictions)	some logging roads access the west flank. Surrounded by Parks.	3
K.5	Terrain and distance factor for road building	No new road requirement.	5
L.	**Development Finance**		0.00
L.1	Development value (greenhouses; tourism; heating; etc.)		0
L.2	Market price for similar commodities not using direct-use heat		0
L.3	Green power premium for commodity?		0
L.4	Commodity price		0
L.5	Marketing implications		0
L.6	Estimated size of resource		0
L.7	Are there any green use incentives?		0
L.8	Grants		0
L.9	Tax holidays		0
L.10	Tax relief		0
L.11	Loan guarantees		0
L.12	Royalties/Fees		0
L.13	General idea of royalties		0
L.14	Private land owner or government land		0
L.15	Tax rate in the country		0
L.16	Transmission Tariffs		0

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Mt. Garibaldi	
	Nearest community name:	Squamish	
	Nearest large community:	North Vancouver	
	Topographic map sheets (name and code) :	Cheakamus River, 092G14	
	Geological map sheets (name and code)	92G.085	
M.	**Maps**		5.00
M.1	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)		5
M.2	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks) (1:500,000?)		5
M.3	Regional geological map (1:250 or 500,000?)		5
M.4	Detailed geological map of the immediate area of the concessions (1:50,000 or 100,000)		5
N.	**Other issues and considerations**		3.67
N.1	Spatial concentration of potential customers	Squamish is a major tourist centre;	5
N.2	Distance to market for prospective commodities	gravel roads along west flank not maintained in winter	1
N.3	Costs to potential customers to receive Direct-use benefits	close population and high tourist visitation	5

OVERALL COMMENTS/ASSESSMENT	proximity to Squamish and major route to Whistler makes this area worth some additional investigation along the west flanks of Garibaldi.

GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
AREA OF INTEREST:	Mt. Silverthrone	
Nearest community name:	Campbell River	
Nearest large community:	Vancouver	
Topographic map sheets (name and code) :	Klinaklini Glacier, 092N05	
Geological map sheets (name and code)	92N.022	

Mt. Silverthrone

A.	**Resource potential**		2.86
A.1	General geological setting	young volcanism around Franklin Glacier as well as major caldera complex at Silverthrone and large structures	5
A.2	Size/potential/type	small to medium from electrical potential	3
A.3	Temperature gradient/ Heat flow data	limited data; may be northern limit of Garibaldi volcanic belt; young volcanism along coastal areas (for example Milbanke sound)	3
A.4	Water & Gas chemistry	extensive alteration near volcanic center	3
A.5	Mineral indicators and/or surface alteration	yes; around Silverthrone volcano and Hoodoo Creek	3
A.6	Surface thermal features (type, temperature)	Hoodoo creek has most significant features	3
A.7	Surface spring flow rates and Resource recharge	no flow rates reported	2
A.8	3D permeability (heat exchange potential)	unknown reservoir	2
A.9	Recent magmatism	yes; youngest is just post glacial (<10k)	5
A.10	Structural setting / seismic / tectonics	young volcanism nearby and large structures	5
A.11	Geophysics (type and interpretation if available)	no information	0
A.12	Potential Resource host rocks	crystalline basement rocks	3
A.13	Potential drilling issues	access; rugged terrain	0
A.14	Brief description of geological setting of thermal features (i.e. springs emanate from fluvial gravels; beside a river; etc.)	springs are associated with young volcanism at Silverthrone (or Franklin Glacier); Silverthrone is an evolved center of dacite and rhyolite.	3
B.	**Exploration Uncertainty (Risk)**		1.14
B.1	Degree of identification of resources/reserves	no reservoir has been identified	1
B.2	Likelihood of covering Resource with concession	geothermal concession but has been cancelled.	3
B.3	Expected authorization date	unknown	0
B.4	Specific timing of exploration (2 + 2 years, BC 8 years, etc.)	7 yr., dependent on permitting, access.	1
B.5	Degree of previous exploration (can be good or bad)	Geological mapping	1
B.6	Surface Operational capacity (enough stable area for drilling and facilities planned?)	difficult in areas of springs but closer to Klinaklina River may be possible. Little infrastructure.	1
B.7	Exploration to exploitation (Difficult to easy)	good possibility of finding resource of <80C, very remote area.	1
C.	**Environmental Issues**		2.00
C.1	Protected areas (type and classification)	conservancy area around head of Knight inlet , proposed transmission/piping line in section of Elk falls Provincial Park, Rock Bay marine Provincial park <1km from proposed transmission/piping line.	1
C.2	Endangered species	plants at risk within 5 km, amphibians possible	2
C.3	Geothermal surface features	yes, but Hoodoo has very difficult access (no soaking pools due to topography); Klinaklina also difficult access.	3
C.4	Other	many river crossing with salmon, proposed wildlife habitat area for Marbled Murrelet <3km away from proposed transmission/piping.	2
D.	**Geothermal Area - Bidding and/or type of land holding (private/gov/lease/etc.)**		3.00
D.1	Bidding Area	cancelled geothermal lease. Permission to use Crown land is obtained by application under the Land Act (LA); target would be lower temperature < 80°C resource.	3

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Mt. Silverthrone	
	Nearest community name:	Campbell River	
	Nearest large community:	Vancouver	
	Topographic map sheets (name and code) :	Klinaklini Glacier, 092N05	
	Geological map sheets (name and code)	92N.022	
D.2	Electrical generation potential? competition or collaboration possible from Companies present	yes, geothermal exploration has been undertaken, no development underway, but not favourable economics (see KWL report)	1
D.3	Other claim rights (Mining and/or Oil)	none known	5
E.	**Market**		1.75
E.1	Potential commodities for direct use applications	local forest products (mushrooms, plants, fish and logging); no close population; remote and limited access.	3
E.2	Political stability and community relationship to development	First nations interest; no population close by.	1
E.3	Time Limits? (Business agreements, Operating/generating-by deadlines?)	nothing planned	3
E.4	Renewable energy "green value" for potential development	n/a	0
F.	**Transmission Line Infrastructure**		0.00
F.1	State of the Infrastructure	no close transmission >150 km away	0
F.2	Transmission route (distance, terrain and costs)	would need a submarine cable to bring to site	0
F.3	Wheeling power	n/a	0
F.4	Transmission providers	n/a	0
G.	**Laws governing direct-use renewable energy sources**		3.43
G.1	General Criteria of the Geothermal Law	important aspect is the temperature criteria; under 80 C Crown Land Tenure; above geothermal law.	3
G.2	General Criteria of the water resources law	need a water use licence	3
G.3	Direct sales possible	yes, with a licence	3
G.4	Carbon credits	BC Carbon Registry (new, in place 2016), Carbon Tax	4
G.5	Lease time and ability to renew or extend exploration licence	geothermal lease expired, could be done under Land Act tenure	3
G.6	Issues (and timing) related to conversion from exploration to exploitation	If done under a geothermal lease specific work program is required.	3
G.7	Time frame for exploitation licence	Crown land tenure takes weeks to months, depending on the length of tenure requested; lease up to 30 years; Provincial Park	5
H.	**Community Issues**		2.56
H.1	Indigenous Law and Indigenous Development Areas	Da'naxda'xw/Awaetlala First Nation Stage 4 in BC treaty negotiation	3
H.2	Land claims	Nanwakolas and Tl'etinqox-T'in Government Office (Anahim Band) assert territorial rights but not in treaty negotiation.	1
H.3	Community action	Campbell River has a community plan with GHGE reduction target	5
H.4	Surface Rights	crown land; conservancy area	3
H.5	Visual considerations	logging in valley, remote area	2
H.6	Tourism	very limited; remote area	0
H.7	Traditional use area: trapping, hunting, food and medicinal plants, fishing activities	asserted right in area	3
H.8	Traditional use area: Community sacred site, gathering place or event sites	as above	3
H.9	Traditional use area: archeology sites and other areas of significance	as above	3

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Mt. Silverthrone	
	Nearest community name:	Campbell River	
	Nearest large community:	Vancouver	
	Topographic map sheets (name and code) :	Klinaklini Glacier, 092N05	
	Geological map sheets (name and code)	92N.022	
I.	**Water rights**		5.00
I.1	availability for proposed development	No existing water licenses	5
I.2	availability for drilling	yes, with a licence	5
J.	**Engineering**		1.20
J.1	Development proposal and design	no development proposed	0
J.2	Construction issues	steep terrain; old logging roads; remote	0
J.3	Transportation issues	access by water/old logging roads	0
J.4	Architectural Issues (blend/hide into environment? Local styles? Etc.)	none known	3
J.5	Special construction issues (heat exchanger & full injection)	none known	3
K.	**Non electrical infrastructure (roads and habitation)**		1.40
K.1	Nearest large community > 50,000	Vancouver (by boat and highway)	3
K.2	nearest community and size	Campbell River population in 2011 was 31,188; access is by boat	1
K.3	Nearest road and condition	marine access to Vancouver Island highway; unpaved logging roads within site distance.	1
K.4	Current access conditions (restrictions)	165 km on existing unpaved roads of unknown condition.	1
K.5	Terrain and distance factor for road building	marine access to Vancouver Island highway; condition of existing roads unknown	1
L.	**Development Finance**		0.00
L.1	Development value (greenhouses; tourism; heating; etc.)		0
L.2	Market price for similar commodities not using direct-use heat		0
L.3	Green power premium for commodity?		0
L.4	Commodity price		0
L.5	Marketing implications		0
L.6	Estimated size of resource		0
L.7	Are there any green use incentives?		0
L.8	Grants		0
L.9	Tax holidays		0
L.10	Tax relief		0
L.11	Loan guarantees		0
L.12	Royalties/Fees		0
L.13	General idea of royalties		0
L.14	Private land owner or government land		0
L.15	Tax rate in the country		0
L.16	Transmission Tariffs		0
M.	**Maps**		5.00
M.1	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)		5
M.2	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks) (1:500,000?)		5

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Mt. Silverthrone	
	Nearest community name:	Campbell River	
	Nearest large community:	Vancouver	
	Topographic map sheets (name and code) :	Klinaklini Glacier, 092N05	
	Geological map sheets (name and code)	92N.022	
M.3	Regional geological map (1:250 or 500,000?)		5
M.4	Detailed geological map of the immediate area of the concessions (1:50,000 or 100,000)		5
N.	**Other issues and considerations**		0.33
N.1	Spatial concentration of potential customers	very remote location; marine access	0
N.2	Distance to market for prospective commodities	marine access to Vancouver Island highway	1
N.3	Costs to potential customers to receive Direct-use benefits	high due to distance from population	0

OVERALL COMMENTS/ASSESSMENT	Very remote location with no local population; limited tourist activity, very rugged (along the west side of Mount Waddington).

GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
AREA OF INTEREST:	Nazko Cone	
Nearest community name:	Quesnel	
Nearest large community:	Prince George	
Topographic map sheets (name and code) :	Marmot Lake, 093B13	
Geological map sheets (name and code)	93B.092	

Nazko Cone

A.	**Resource potential**		4.00
A.1	General geological setting	young volcanism nearby and large structures; actual cinder cone is 20 km from Nazko community; in Quesnel, large faults and pozalite locality.	5
A.2	Size/potential/type	small from electrical potential; no defined reservoir	3
A.3	Temperature gradient/ Heat flow data	area of moderate heat flow	5
A.4	Water & Gas chemistry	nearby gas seeps with magmatic signature but likely related to underlying limestone deposits with small magmatic influence	3
A.5	Mineral indicators and/or surface alteration	yes; tufa deposits related to CO2 seeps	3
A.6	Surface thermal features (type, temperature)	cold springs with CO2 seeps	3
A.7	Surface spring flow rates and Resource recharge	very low flow rate reported; but bogs cover a substantial area.	3
A.8	3D permeability (heat exchange potential)	unknown reservoir	3
A.9	Recent magmatism	youngest is Nazko dated at 7,200 yrBP; large volume post glacial flow to the NW of Nazko Cone	5
A.10	Structural setting / seismic / tectonics	young volcanism nearby and large structures mapped	5
A.11	Geophysics (type and interpretation if available)	regional magnetics, gravity and MT as well as seismic exist; geophysics suggest a deep-seated (400 km) low-velocity zone that may be the source of volcanism (substantiates hot spot hypothesis).	5
A.12	Potential Resource host rocks	sedimentary basement rocks	5
A.13	Potential drilling issues	access is by gravel logging roads.	3
A.14	Brief description of geological setting of thermal features (i.e. springs emanate from fluvial gravels; beside a river; etc.)	Young volcanism and CO2 seeps and moderate heat flow in the area suggest that temperatures high enough for Direct-use may be accessible at depths less than 3 km.	5
B.	**Exploration Uncertainty (Risk)**		2.43
B.1	Degree of identification of resources/reserves	no reservoir has been identified	1
B.2	Likelihood of covering Resource with concession	possible; resource review has been carried out but no obvious targets without additional geoscience; private and First Nations land holdings	3
B.3	Expected authorization date	unknown reservoir	0
B.4	Specific timing of exploration (2 + 2 years, BC 8 years, etc.)	5-7 years, once permits in place	3
B.5	Degree of previous exploration (can be good or bad)	some exploration (geophysics, geological); no targets generated	2
B.6	Surface Operational capacity (enough stable area for drilling and facilities planned?)	no hot springs, but cold springs and CO2 seeps with magmatic signature.	3
B.7	Exploration to exploitation (Difficult to easy)	good possibility of finding resource of <80C	5
C.	**Environmental Issues**		2.50
C.1	Protected areas (type and classification)	limited within the area of interest, Puntchesakut Lake and Pinnacles Provincial Parks within 2 km of proposed transmission/piping route.	3
C.2	Endangered species	White Sturgeon in Fraser River (proposed transmission/piping route), plants at risk	2
C.3	Geothermal surface features	travertine and CO2 seep used by wildlife	3
C.4	Other	river crossings with fish to access the area	2
D.	**Geothermal Area - Bidding and/or type of land holding (private/gov/lease/etc.)**		2.33

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Nazko Cone	
	Nearest community name:	Quesnel	
	Nearest large community:	Prince George	
	Topographic map sheets (name and code) :	Marmot Lake, 093B13	
	Geological map sheets (name and code)	93B.092	
D.1	Bidding Area	no geothermal leases; private and First Nations land. Permission to use Crown land is obtained by application under the Land Act (LA); target would be lower temperature < 80°C resource.	3
D.2	Electrical generation potential? competition or collaboration possible from Companies present	yes, geothermal exploration has been contemplated, no development underway, but not favourable economics (see KWL report)	1
D.3	Other claim rights(Mining and/or Oil)	proposed resource area is within existing mineral/coal titles.	3
E.	**Market**		3.50
E.1	Potential commodities for direct use applications	local forest products (mushrooms, plants, fish and logging); limited close population; Quesnel driving time ~1.5 hrs.	3
E.2	Political stability and community relationship to development	First nations interest; already invested in a resource review.	5
E.3	Time Limits? (Business agreements, Operating/generating-by deadlines?)	nothing planned; have had resource reviews and expert input	3
E.4	Renewable energy "green value" for potential development	moderate; remote site	3
F.	**Transmission Line Infrastructure**		0.00
F.1	State of the Infrastructure	closest transmission/substation ~100 km away	0
F.2	Transmission route (distance, terrain and costs)	need to upgrade transmission if need for power was high	0
F.3	Wheeling power	n/a	0
F.4	Transmission providers	n/a	0
G.	**Laws governing direct-use renewable energy sources**		3.43
G.1	General Criteria of the Geothermal Law	important aspect is the temperature criteria; under 80 C Crown Land Tenure; above geothermal law.	3
G.2	General Criteria of the water resources law	need a water use licence	3
G.3	Direct sales possible	yes, with a licence	3
G.4	Carbon credits	BC Carbon Registry (new, in place 2016), Carbon Tax	4
G.5	Lease time and ability to renew or extend exploration licence	geothermal lease expired, could be done under Land Act tenure	3
G.6	Issues (and timing) related to conversion from exploration to exploitation	If done under a geothermal lease specific work program is required.	3
G.7	Time frame for exploitation licence	Crown land tenure takes weeks to months, depending on the length of tenure requested; lease up to 30 years; Provincial Park	5
H.	**Community Issues**		2.67
H.1	Indigenous Law and Indigenous Development Areas	Nazko First Nation BCTC stage 4	1
H.2	Land claims	asserted territory by Lhtako Dene Nation; Tsilhqot'in National government (not currently in negotiation)	1
H.3	Community action	Nazko Nation involved in 2 resource review studies; Kunkle PhD focused on renewable energy and Aboriginal communities; Quesnel also did review of renewable energy possibilities; local interest in Pozalite deposit and potential for warm waters along major structures.	5
H.4	Surface Rights	private and First Nations	3
H.5	Visual considerations	logging in area	3

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Nazko Cone	
	Nearest community name:	Quesnel	
	Nearest large community:	Prince George	
	Topographic map sheets (name and code) :	Marmot Lake, 093B13	
	Geological map sheets (name and code)	93B.092	
H.6	Tourism	limited tourism; hunting, fishing, cross country skiing.	2
H.7	Traditional use area: trapping, hunting, food and medicinal plants, fishing activities	First Nations assert ownership	3
H.8	Traditional use area: Community sacred site, gathering place or event sites	as above	3
H.9	Traditional use area: archeology sites and other areas of significance	as above	3
I.	**Water rights**		5.00
I.1	availability for proposed development	1 current water license in the area	5
I.2	availability for drilling	yes, with a licence	5
J.	**Engineering**		1.60
J.1	Development proposal and design	no development proposed	0
J.2	Construction issues	steep terrain; gravel access road subject to washouts.	1
J.3	Transportation issues	gravel road not maintained in winter	1
J.4	Architectural Issues (blend/hide into environment? Local styles? Etc.)	none known	3
J.5	Special construction issues (heat exchanger & full injection)	none known	3
K.	**Non electrical infrastructure (roads and habitation)**		3.80
K.1	Nearest large community > 50,000	Prince George	5
K.2	nearest community and size	Quesnel (local population 10,000; regional adds another 13,000)	2
K.3	Nearest road and condition	paved all weather road maintained in winter; logging roads to more remote sites	5
K.4	Current access conditions (restrictions)	none known, 100 km from Quesnel	2
K.5	Terrain and distance factor for road building	no new roads required	5
L.	**Development Finance**		0.00
L.1	Development value (greenhouses; tourism; heating; etc.)		0
L.2	Market price for similar commodities not using direct-use heat		0
L.3	Green power premium for commodity?		0
L.4	Commodity price		0
L.5	Marketing implications		0
L.6	Estimated size of resource		0
L.7	Are there any green use incentives?		0
L.8	Grants		0
L.9	Tax holidays		0
L.10	Tax relief		0
L.11	Loan guarantees		0
L.12	Royalties/Fees		0
L.13	General idea of royalties		0
L.14	Private land owner or government land		0
L.15	Tax rate in the country		0
L.16	Transmission Tariffs		0
M.	**Maps**		5.00

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Nazko Cone	
	Nearest community name:	Quesnel	
	Nearest large community:	Prince George	
	Topographic map sheets (name and code) :	Marmot Lake, 093B13	
	Geological map sheets (name and code)	93B.092	
M.1	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)		5
M.2	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks) (1:500,000?)		5
M.3	Regional geological map (1:250 or 500,000?)		5
M.4	Detailed geological map of the immediate area of the concessions (1:50,000 or 100,000)		5
N.	**Other issues and considerations**		2.33
N.1	Spatial concentration of potential customers	limited number in local communities;	2
N.2	Distance to market for prospective commodities	paved road maintained in winter	4
N.3	Costs to potential customers to receive Direct-use benefits	limited local population	1

OVERALL COMMENTS/ASSESSMENT	Nazko has undertaken two geothermal reviews; both suggest the possibility of resources sufficient for Direct-use, but limited ability of the community to undertake exploration and development. Funding needed to move ahead with TG drilling to assess regional temperature gradient.

GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
AREA OF INTEREST:	Okanagan	
Nearest community name:	Peachland	
Nearest large community:	Kelowna	
Topographic map sheets (name and code) :	Summerland, 082E12	
Geological map sheets (name and code)	82E.061	

Okanagan

A.	**Resource potential**		3.86
A.1	General geological setting	well known	5
A.2	Size/potential/type	Springbook formation estimated 60m thick over 100 km2 area	5
A.3	Temperature gradient/ Heat flow data	Temperature gradient estimated 50C/km, heat flow estimates 70-85 mW/m2.	5
A.4	Water & Gas chemistry	Angel spring (aka KLO) 23C, Geothermometry calculation up to 137C. HCO3 815 mg/L, Mg 27 mg/L, Cl 4 mg/L.	5
A.5	Mineral indicators and/or surface alteration	Extensive tufa deposits at Angel Spring.	5
A.6	Surface thermal features (type, temperature)	Angel Spring 23C located 50 km NE of Summerland borehole EPB/GSC 495	5
A.7	Surface spring flow rates and Resource recharge	Artesian conditions. 3-10 L/s estimate.	3
A.8	3D permeability (heat exchange potential)	conduction or deep fluid circulation within sedimentary and volcanic formations. Thin permeable interbedded layers, tops of basic lavas, basal conglomerate and along faults.	3
A.9	Recent magmatism	50M ago	0
A.10	Structural setting / seismic / tectonics	Lots of evidence of fracturing/faulting and graben-like structures, overall basin-and-range style setting.	5
A.11	Geophysics (type and interpretation if available)	Regional	3
A.12	Potential Resource host rocks	Likely basal conglomerate, also perhaps breccia lenses in fault zones. Silicate host?	3
A.13	Potential drilling issues	naturally radioactive (heavy metal) minerals present in area previously detected in groundwater	2
A.14	Brief description of geological setting of thermal features (i.e. springs emanate from fluvial gravels; beside a river; etc.)	Extensional environment. Okanagan Valley Fault associated with location of Angel Spring. Last known volcanic (50M ago) deposits preserved in grabens, half-grabens and cauldron-subsidence complexes.	5
B.	**Exploration Uncertainty (Risk)**		2.00
B.1	Degree of identification of resources/reserves	Potential resource, but no viable aquifers identified yet.	1
B.2	Likelihood of covering Resource with concession	Extent of geothermal area requires definition. Angel Spring is within Myra-Bellevue Provincial Park.	1
B.3	Expected authorization date	No geothermal tracts nearby.	0
B.4	Specific timing of exploration (2 + 2 years, BC 8 years, etc.)	as soon as permits can be put in place, 5-7 yr.	3
B.5	Degree of previous exploration (can be good or bad)	Geoscientific information exists. Geothermometry studies exist. TG and heat flow data known for general area. A few gradient/exploration wells drilled but dispersed throughout basin areas.	2
B.6	Surface Operational capacity (enough stable area for drilling and facilities planned?)	Likely	5
B.7	Exploration to exploitation (Difficult to easy)	More resource definition required.	2
C.	**Environmental Issues**		2.75
C.1	Protected areas (type and classification)	Wildlife Habitat Area approx. 3 km from potential resource location. Darke Lake Provincial Park ~10 km away.	2
C.2	Endangered species	American Badger, Western Screech-Owl, Prairie Gentian occurrences are along proposed transmission/piping route.	2
C.3	Geothermal surface features	Nearest hot springs approx. 70 km from potential resource area.	5
C.4	Other	Potential transmission/piping line crosses fish bearing streams.	2

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Okanagan	
	Nearest community name:	Peachland	
	Nearest large community:	Kelowna	
	Topographic map sheets (name and code) :	Summerland, 082E12	
	Geological map sheets (name and code)	82E.061	
D.	**Geothermal Area - Bidding and/or type of land holding (private/gov/lease/etc.)**		3.00
D.1	Bidding Area	No geothermal tracts nearby. Permission to use Crown land is obtained by application under the Land Act (LA); target would be lower temperature < 80°C resource.	3
D.2	Electrical generation potential? competition or collaboration possible from Companies present	KWL report	3
D.3	Other claim rights(Mining and/or Oil)	several mineral/coal titles in the area.	3
E.	**Market**		3.50
E.1	Potential commodities for direct use applications	closest community Summerland. Greenhouses, mushroom drying, forest products etc.	3
E.2	Political stability and community relationship to development	stable, openness to development but favourability to specific direct-use applications unestablished.	3
E.3	Time Limits? (Business agreements, Operating/generating-by deadlines?)	None known.	3
E.4	Renewable energy "green value" for potential development	Communities nearby favourable to green development.	5
F.	**Transmission Line Infrastructure**		0.50
F.1	State of the Infrastructure	closest substation is 23 km away	1
F.2	Transmission route (distance, terrain and costs)	23 km of new 63 kV transmission line along existing paved road.	1
F.3	Wheeling power	n/a	0
F.4	Transmission providers	n/a	0
G.	**Laws governing direct-use renewable energy sources**		3.43
G.1	General Criteria of the Geothermal Law	important aspect is the temperature criteria; under 80 C Crown Land Tenure; above geothermal law.	3
G.2	General Criteria of the water resources law	need a water use licence	3
G.3	Direct sales possible	yes, with a licence	3
G.4	Carbon credits	BC Carbon Registry (new, in place 2016), Carbon Tax	4
G.5	Lease time and ability to renew or extend exploration licence	could be done under geothermal/Land Act tenure.	3
G.6	Issues (and timing) related to conversion from exploration to exploitation	If done under a geothermal lease specific work program is required.	3
G.7	Time frame for exploitation licence	Crown land tenure takes weeks to months, depending on the length of tenure requested; lease up to 30 years	5
H.	**Community Issues**		2.89
H.1	Indigenous Law and Indigenous Development Areas	within Westbank Stage 4 BCTC treaty area	1
H.2	Land claims	within Okanagan Nation Alliance (Syilx) asserted territory	1
H.3	Community action	Westbank First Nation provides Land Use Plan for communities in Summerland. Summerland signed onto BC Climate Action Charter.	4
H.4	Surface Rights	treaty and crown land, nearby Provincial Park	3
H.5	Visual considerations	logging areas and roads nearby. Wine country nearby.	5
H.6	Tourism	Summerland has a significant ecotourism industry; four Provincial Park protected areas are within 6 km of the location of the proposed resource area and transmission route. (http://www.summerland.ca/)	3

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Okanagan	
	Nearest community name:	Peachland	
	Nearest large community:	Kelowna	
	Topographic map sheets (name and code) :	Summerland, 082E12	
	Geological map sheets (name and code)	82E.061	
H.7	Traditional use area: trapping, hunting, food and medicinal plants, fishing activities	Westbank First Nation, Okanagan Nation Alliance	3
H.8	Traditional use area: Community sacred site, gathering place or event sites	Westbank First Nation, Okanagan Nation Alliance	3
H.9	Traditional use area: archeology sites and other areas of significance	Westbank First Nation, Okanagan Nation Alliance	3
I.	**Water rights**		5.00
I.1	availability for proposed development	closest water licenses ~10 km from proposed resource area.	5
I.2	availability for drilling	closest water licenses ~10 km from proposed resource area.	5
J.	**Engineering**		2.60
J.1	Development proposal and design	no planning underway	0
J.2	Construction issues	Short <1km road may be required.	3
J.3	Transportation issues	Access via existing paved roads and unpaved access roads.	4
J.4	Architectural Issues (blend/hide into environment? Local styles? Etc.)	none known	3
J.5	Special construction issues (heat exchanger & full injection)	none known	3
K.	**Non electrical infrastructure (roads and habitation)**		3.40
K.1	Nearest large community > 50,000	Kelowna	5
K.2	nearest community and size	Peachland (pop 5000)	2
K.3	Nearest road and condition	unpaved existing logging road	3
K.4	Current access conditions (restrictions)	unpaved road access to potential resource area	3
K.5	Terrain and distance factor for road building	may require short (<1km) new road, forested, gentle to moderate slope	4
L.	**Development Finance**		0.00
L.1	Development value (greenhouses; tourism; heating; etc.)		0
L.2	Market price for similar commodities not using direct-use heat		0
L.3	Green power premium for commodity?		0
L.4	Commodity price		0
L.5	Marketing implications		0
L.6	Estimated size of resource		0
L.7	Are there any green use incentives?		0
L.8	Grants		0
L.9	Tax holidays		0
L.10	Tax relief		0
L.11	Loan guarantees		0
L.12	Royalties/Fees		0
L.13	General idea of royalties		0
L.14	Private land owner or government land		0
L.15	Tax rate in the country		0
L.16	Transmission Tariffs		0
M.	**Maps**		5.00
M.1	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)		5

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Okanagan	
	Nearest community name:	Peachland	
	Nearest large community:	Kelowna	
	Topographic map sheets (name and code) :	Summerland, 082E12	
	Geological map sheets (name and code)	82E.061	
M.2	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks) (1:500,000?)		5
M.3	Regional geological map (1:250 or 500,000?)		5
M.4	Detailed geological map of the immediate area of the concessions (1:50,000 or 100,000)		5
N.	**Other issues and considerations**		4.00
N.1	Spatial concentration of potential customers	Peachland (pop 5000), Kelowna is major center and close by	4
N.2	Distance to market for prospective commodities	Kelowna (close by)	5
N.3	Costs to potential customers to receive Direct-use benefits	no subsidies, short distances decrease cost.	3

OVERALL COMMENTS/ASSESSMENT	Potential for development with nearby large market (Kelowna). Remote, requires long transmission/piping potentially. Resource requires definition.

GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
AREA OF INTEREST:	Sloquet Creek	
Nearest community name:	Harrison Hot Springs	
Nearest large community:	Maple Ridge	
Topographic map sheets (name and code) :	Stave River, 092G09	
Geological map sheets (name and code)	92G.079	

Sloquet Creek

A.	**Resource potential**		3.07
A.1	General geological setting	well known	5
A.2	Size/potential/type	Unknown, based on assumptions, perhaps 2 km3.	3
A.3	Temperature gradient/ Heat flow data	no current TG data available. Geothermometry suggests 100-110C source waters.	3
A.4	Water & Gas chemistry	water chemistry: 440 ppm SO4, 375 mg/L SO4, Cl=60mg/l	3
A.5	Mineral indicators and/or surface alteration	Opal, gypsum and sinter.	4
A.6	Surface thermal features (type, temperature)	49C-71C for August Jakob's and Sloquet	5
A.7	Surface spring flow rates and Resource recharge	100L/min, better estimate required.	3
A.8	3D permeability (heat exchange potential)	Unknown	3
A.9	Recent magmatism	18-8M yr. ago	0
A.10	Structural setting / seismic / tectonics	Lots of evidence of faulting in the area.	3
A.11	Geophysics (type and interpretation if available)	Regional available. Local resistivity study but did not yield target.	2
A.12	Potential Resource host rocks	not defined, potentially volcanic	3
A.13	Potential drilling issues	popular recreational area	1
A.14	Brief description of geological setting of thermal features (i.e. springs emanate from fluvial gravels; beside a river; etc.)	Location of springs possibly controlled by faulting along creek, water flows from vertical fractures and accompanied by sulfurous odor and sinter deposits.	5
B.	**Exploration Uncertainty (Risk)**		2.86
B.1	Degree of identification of resources/reserves	Surface manifestation but resource not defined. Need to define depths of water <80C.	2
B.2	Likelihood of covering Resource with concession	Mineral titles north and east by gold exploration company. Not located within protected park area. First Nation consultation will be required.	4
B.3	Expected authorization date	unknown	0
B.4	Specific timing of exploration (2 + 2 years, BC 8 years, etc.)	5-6 years if not permitting issues.	3
B.5	Degree of previous exploration (can be good or bad)	Gold exploration north of springs, no focus on geothermal reservoir definition.	3
B.6	Surface Operational capacity (enough stable area for drilling and facilities planned?)	River valley is heavily forested but logging activity may provide clearings and access roads.	4
B.7	Exploration to exploitation (Difficult to easy)	Access, community acceptance, active mineral exploration, but reservoir still requires definition	4
C.	**Environmental Issues**		3.00
C.1	Protected areas (type and classification)	Garibaldi and Golden Ears Provincial Parks ~5 km away.	2
C.2	Endangered species	Pygmy Longfin Smelt area 8 km away.	4
C.3	Geothermal surface features	yes, very popular recreational area.	3
C.4	Other	nearest Wildlife Habitat Area (Spotted Owl) ~15 km away, Sloquet creek contains spawning locations for various species of Salmon. Mountain goat habitat ~2 km away. Multiple Mule Deer habitats 2-10 km away.	3
D.	**Geothermal Area - Bidding and/or type of land holding (private/gov/lease/etc.)**		3.00
D.1	Bidding Area	No geothermal tracts in the area. Permission to use Crown land is obtained by application under the Land Act (LA); target would be lower temperature < 80°C resource.	3
D.2	Electrical generation potential? competition or collaboration possible from Companies present	Hydro-electric development nearby. KWL report.	3

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Sloquet Creek	
	Nearest community name:	Harrison Hot Springs	
	Nearest large community:	Maple Ridge	
	Topographic map sheets (name and code) :	Stave River, 092G09	
	Geological map sheets (name and code)	92G.079	
D.3	Other claim rights(Mining and/or Oil)	Within mineral/coal title claims.	3
E.	**Market**		3.50
E.1	Potential commodities for direct use applications	Closest community Harrison Lake is small (pop 1500)	3
E.2	Political stability and community relationship to development	First Nations interest, but consultations will be required.	3
E.3	Time Limits? (Business agreements, Operating/generating-by deadlines?)	None known	3
E.4	Renewable energy "green value" for potential development	First Nations interest, but consultations will be required.	5
F.	**Transmission Line Infrastructure**		3.75
F.1	State of the Infrastructure	forestry and hydro-electric access nearby	5
F.2	Transmission route (distance, terrain and costs)	<1 km to Innergex 138 kV transmission line	5
F.3	Wheeling power	n/a	0
F.4	Transmission providers	BC Hydro	5
G.	**Laws governing direct-use renewable energy sources**		3.43
G.1	General Criteria of the Geothermal Law	important aspect is the temperature criteria; under 80 C Crown Land Tenure; above geothermal law.	3
G.2	General Criteria of the water resources law	need a water use licence	3
G.3	Direct sales possible	yes, with a licence	3
G.4	Carbon credits	BC Carbon Registry (new, in place 2016), Carbon Tax	4
G.5	Lease time and ability to renew or extend exploration licence	lease has been renewed once; could be done under crown land tenure	3
G.6	Issues (and timing) related to conversion from exploration to exploitation	If done under a geothermal lease specific work program is required.	3
G.7	Time frame for exploitation licence	Crown land tenure takes weeks to months, depending on the length of tenure requested; lease up to 30 years	5
H.	**Community Issues**		2.89
H.1	Indigenous Law and Indigenous Development Areas	different stages; two groups (In-SHUCK-ch, Stó:lō)	1
H.2	Land claims	within asserted territory areas of In-SHUCK-ch, Stó:lō Nations, St'at'imc Chiefs Council, Sts'ailes band.	1
H.3	Community action	Sloquet hot springs run as joint venture between BC govt and First Nations. Tsek' (Skookumchuck) hot springs nearby run by In-SHUCK-ch Nation.	4
H.4	Surface Rights	treaty and crown land	3
H.5	Visual considerations	lots of forestry and hydro-electric access	5
H.6	Tourism	springs used for bathing.	3
H.7	Traditional use area: trapping, hunting, food and medicinal plants, fishing activities	In-SHUCK-ch, Stó:lō Nations bands, Lillooet Tribal Council, St'at'imc Chiefs Council and Sts'ailes.	3
H.8	Traditional use area: Community sacred site, gathering place or event sites	In-SHUCK-ch, Stó:lō Nations bands, Lillooet Tribal Council, St'at'imc Chiefs Council and Sts'ailes.	3
H.9	Traditional use area: archeology sites and other areas of significance	In-SHUCK-ch, Stó:lō Nations bands, Lillooet Tribal Council, St'at'imc Chiefs Council and Sts'ailes.	3
I.	**Water rights**		5.00
I.1	availability for proposed development	No water licenses in the area	5
I.2	availability for drilling	Yes, with a water license.	5
J.	**Engineering**		2.80

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Sloquet Creek	
	Nearest community name:	Harrison Hot Springs	
	Nearest large community:	Maple Ridge	
	Topographic map sheets (name and code) :	Stave River, 092G09	
	Geological map sheets (name and code)	92G.079	
J.1	Development proposal and design	no planning underway	0
J.2	Construction issues	nearby access	4
J.3	Transportation issues	nearby access	4
J.4	Architectural Issues (blend/hide into environment? Local styles? Etc.)	none known	3
J.5	Special construction issues (heat exchanger & full injection)	none known	3
K.	**Non electrical infrastructure (roads and habitation)**		3.00
K.1	Nearest large community > 50,000	Maple Ridge, BC	4
K.2	nearest community and size	Harrison Lake, BC (has hot spring resort area)	2
K.0	Nearest road and condition	nearest logging unpaged road within 1 km of resource area. Road to Harrison Hot Springs not maintained in winter.	3
K.4	Current access conditions (restrictions)	Via existing unpaved logging roads. Road to Harrison Hot Springs not maintained in winter.	3
K.5	Terrain and distance factor for road building	No new road construction required, but road to Harrison will need upgrading as it is prone to washouts.	3
L.	**Development Finance**		0.00
L.1	Development value (greenhouses; tourism; heating; etc.)		0
L.2	Market price for similar commodities not using direct-use heat		0
L.3	Green power premium for commodity?		0
L.4	Commodity price		0
L.5	Marketing implications		0
L.6	Estimated size of resource		0
L.7	Are there any green use incentives?		0
L.8	Grants		0
L.9	Tax holidays		0
L.10	Tax relief		0
L.11	Loan guarantees		0
L.12	Royalties/Fees		0
L.13	General idea of royalties		0
L.14	Private land owner or government land		0
L.15	Tax rate in the country		0
L.16	Transmission Tariffs		0
M.	**Maps**		5.00
M.1	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)		5
M.2	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks) (1:500,000?)		5
M.3	Regional geological map (1:250 or 500,000?)		5
M.4	Detailed geological map of the immediate area of the concessions (1:50,000 or 100,000)		5
N.	**Other issues and considerations**		1.67
N.1	Spatial concentration of potential customers	Harrison Lake, BC (pop 1500), rough road	2

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Sloquet Creek	
	Nearest community name:	Harrison Hot Springs	
	Nearest large community:	Maple Ridge	
	Topographic map sheets (name and code) :	Stave River, 092G09	
	Geological map sheets (name and code)	92G.079	
N.2	Distance to market for prospective commodities	Maple Ridge, BC and lower mainland, but road south is not maintained in winter.	2
N.3	Costs to potential customers to receive Direct-use benefits	no subsidies	1

OVERALL COMMENTS/ASSESSMENT	Undefined resource. Good potential. Recreational area. First Nations nearby are involved and may be interested in further development.

GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
AREA OF INTEREST:	Sphaler Creek	
Nearest community name:	Iskut	
Nearest large community:	Prince George	
Topographic map sheets (name and code) :	Sphaler Creek, 104G03	
Geological map sheets (name and code)	104G.005	

Sphaler Creek

A.	**Resource potential**		2.43
A.1	General geological setting	Area is remote mountainous region; young and long lived volcanism in Mt. Edziza area.	3
A.2	Size/potential/type	no specific reservoir - isolated hot springs	0
A.3	Temperature gradient/ Heat flow data	none known; area of high heat flow	3
A.4	Water & Gas chemistry	one sample (see geochemistry Appendix D).	3
A.5	Mineral indicators and/or surface alteration	none reported	0
A.6	Surface thermal features (type, temperature)	very hot ~74° C	5
A.7	Surface spring flow rates and Resource recharge	low; unknown	1
A.8	3D permeability (heat exchange potential)	nothing known; likely structurally controlled	1
A.9	Recent magmatism	Stikine volcanic belt (Northern Cordilleran Volcanic Province)	5
A.10	Structural setting / seismic / tectonics	young faulting and volcanism	5
A.11	Geophysics (type and interpretation if available)	regional	1
A.12	Potential Resource host rocks	fractured basement rocks	3
A.13	Potential drilling issues	remote difficult access	1
A.14	Brief description of geological setting of thermal features (i.e. springs emanate from fluvial gravels; beside a river; etc.)	Close proximity to Mt. Edziza; Bowser Basin to the east.	3
B.	**Exploration Uncertainty (Risk)**		1.29
B.1	Degree of identification of resources/reserves	reservoir not identified; likely fractured bedrock	1
B.2	Likelihood of covering Resource with concession	moderate, may be conflict with mineral tracts.	2
B.3	Expected authorization date	no geothermal leases; could be done under crown land tenure	0
B.4	Specific timing of exploration (2 + 2 years, BC 8 years, etc.)	once permits in place, 5-7 yr.	3
B.5	Degree of previous exploration (can be good or bad)	Surface sampling, geological mapping	1
B.6	Surface Operational capacity (enough stable area for drilling and facilities planned?)	difficult terrain, need for more infrastructure	1
B.7	Exploration to exploitation (Difficult to easy)	Difficult; little resource information	1
C.	**Environmental Issues**		2.75
C.1	Protected areas (type and classification)	Ecological Reserves and Provincial Parks >12.5 km away.	3
C.2	Endangered species	Northern Mountain Caribou 65 km from proposed resource area.	4
C.3	Geothermal surface features	Sphaler Creek hot springs within 5 km of potential resource area, remote tourism.	3
C.4	Other	remote area; spotted owl, grizzly habitat areas nearby; Fish bearing creeks	1
D.	**Geothermal Area - Bidding and/or type of land holding (private/gov/lease/etc.)**		2.33
D.1	Bidding Area	Local mine development may provide potential development. Permission to use Crown land is obtained by application under the Land Act (LA); target would be lower temperature < 80°C resource.	3
D.2	Electrical generation potential? competition or collaboration possible from Companies present	possible collaboration with mineral development. Not favourable economics (KWL report)	1
D.3	Other claim rights(Mining and/or Oil)	mineral/coal leases	3

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Sphaler Creek	
	Nearest community name:	Iskut	
	Nearest large community:	Prince George	
	Topographic map sheets (name and code) :	Sphaler Creek, 104G03	
	Geological map sheets (name and code)	104G.005	
E.	**Market**		2.00
E.1	Potential commodities for direct use applications	Locally gathered forest materials and logging	1
E.2	Political stability and community relationship to development	small communities; mining may promote more emphasis on green energy; community protests over some development.	3
E.3	Time Limits? (Business agreements, Operating/generating-by deadlines?)	no development in planning stage	3
E.4	Renewable energy "green value" for potential development	possible due to proximity of mining	1
F.	**Transmission Line Infrastructure**		0.00
F.1	State of the Infrastructure	power to Bob Quinn Lake, >50 km	0
F.2	Transmission route (distance, terrain and costs)	>50 km of new transmission required thru steep forested terrain.	0
F.3	Wheeling power	n/a	0
F.4	Transmission providers	n/a	0
G.	**Laws governing direct-use renewable energy sources**		3.43
G.1	General Criteria of the Geothermal Law	important aspect is the temperature criteria; under 80°C Crown Land Tenure; above geothermal law.	3
G.2	General Criteria of the water resources law	need a water use licence	3
G.3	Direct sales possible	yes, with a licence	3
G.4	Carbon credits	BC Carbon Registry (new, in place 2016), Carbon Tax	4
G.5	Lease time and ability to renew or extend exploration licence	no geothermal leases; could be done under crown land tenure	3
G.6	Issues (and timing) related to conversion from exploration to exploitation	If done under a geothermal lease specific work program is required.	3
G.7	Time frame for exploitation licence	Crown land tenure takes weeks to months, depending on the length of tenure requested; lease up to 30 years	5
H.	**Community Issues**		2.33
H.1	Indigenous Law and Indigenous Development Areas	Tahltan Central council; supports sustainable and responsible business development. Not currently in negotiation with BC Treaty Commission (high uncertainty)	1
H.2	Land claims	asserted claim but not currently in negotiation with BCTC	1
H.3	Community action	Tahltan Nation Development Council. 2005 community action against Shell Canada.	3
H.4	Surface Rights	1910 Declaration of Tahltan tribe; Tahltan resource development policy; treaty and crown land	3
H.5	Visual considerations	remote wilderness area; logging; mining	3
H.6	Tourism	Tourism underexploited	1
H.7	Traditional use area: trapping, hunting, food and medicinal plants, fishing activities	the Tahltan people look to the land for sustenance, guidance and healing; http://www.tndc.ca/tahltan-people	3
H.8	Traditional use area: Community sacred site, gathering place or event sites	as above	3
H.9	Traditional use area: archeology sites and other areas of significance	as above	3
I.	**Water rights**		5.00
I.1	availability for proposed development	Closest water license ~15km away.	5
I.2	availability for drilling	yes, with a licence	5

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Sphaler Creek	
	Nearest community name:	Iskut	
	Nearest large community:	Prince George	
	Topographic map sheets (name and code) :	Sphaler Creek, 104G03	
	Geological map sheets (name and code)	104G.005	
J.	**Engineering**		1.60
J.1	Development proposal and design	no planning in progress	0
J.2	Construction issues	remote, steep terrain	1
J.3	Transportation issues	remote location	1
J.4	Architectural Issues (blend/hide into environment? Local styles? Etc.)	none known; wilderness area	3
J.5	Special construction issues (heat exchanger & full injection)	none known; remote location	3
K.	**Non electrical infrastructure (roads and habitation)**		1.20
K.1	Nearest large community > 50,000	Prince George	4
K.2	nearest community and size	Iskut, Galore Creek, Bob Quinn Lake	2
K.3	Nearest road and condition	Closest road is 30 km away.	0
K.4	Current access conditions (restrictions)	Remote	0
K.5	Terrain and distance factor for road building	30 km of new road thru steep forested terrain	0
L.	**Development Finance**		0.00
L.1	Development value (greenhouses; tourism; heating; etc.)		0
L.2	Market price for similar commodities not using direct-use heat		0
L.3	Green power premium for commodity?		0
L.4	Commodity price		0
L.5	Marketing implications		0
L.6	Estimated size of resource		0
L.7	Are there any green use incentives?		0
L.8	Grants		0
L.9	Tax holidays		0
L.10	Tax relief		0
L.11	Loan guarantees		0
L.12	Royalties/Fees		0
L.13	General idea of royalties		0
L.14	Private land owner or government land		0
L.15	Tax rate in the country		0
L.16	Transmission Tariffs		0
M.	**Maps**		5.00
M.1	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)		5
M.2	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks) (1:500,000?)		5
M.3	Regional geological map (1:250 or 500,000?)		5
M.4	Detailed geological map of the immediate area of the concessions (1:50,000 or 100,000)		5
N.	**Other issues and considerations**		0.33
N.1	Spatial concentration of potential customers	very remote locations	0

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Sphaler Creek	
	Nearest community name:	Iskut	
	Nearest large community:	Prince George	
	Topographic map sheets (name and code) :	Sphaler Creek, 104G03	
	Geological map sheets (name and code)	104G.005	
N.2	Distance to market for prospective commodities	if mining is viable, potential for cooperation, but new road required	1
N.3	Costs to potential customers to receive Direct-use benefits	high	0

OVERALL COMMENTS/ASSESSMENT	Remote location with limited population and development

GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
AREA OF INTEREST:	Upper Arrow Lake	
Nearest community name:	Revelstoke/Nakusp	
Nearest large community:	Kelowna	
Topographic map sheets (name and code) :	St. Leon Creek, 082K05	
Geological map sheets (name and code)	82K.041	

Upper Arrow Lake

A.	**Resource potential**		3.29
A.1	General geological setting	well known	5
A.2	Size/potential/type	not defined but estimated at 5 km3, low temperature	2
A.3	Temperature gradient/ Heat flow data	32C/km for Columbia River Fault, circulation depth ~4 km	5
A.4	Water & Gas chemistry	Halcyon SO4 400 mg/L, low Mg, Cl; Halfway River, SO4 500 mg/L, low Mg, Cl; Nakusp SO4 300 mg/L, low Mg; St. Leon SO4 560 mg/L, low Mg, Cl.	5
A.5	Mineral indicators and/or surface alteration	none reported	0
A.6	Surface thermal features (type, temperature)	Halcyon 48C, Halfway River 55C, Nakusp 54C, St. Leon 49C, Wilson Lake 30C	5
A.7	Surface spring flow rates and Resource recharge	1-5L/s	3
A.8	3D permeability (heat exchange potential)		3
A.9	Recent magmatism		0
A.10	Structural setting / seismic / tectonics	Lots of evidence of fracturing/faulting and intense folding	5
A.11	Geophysics (type and interpretation if available)	regional	1
A.12	Potential Resource host rocks	Silicate/crystalline schist	5
A.13	Potential drilling issues	potentially a deep resource	2
A.14	Brief description of geological setting of thermal features (i.e. springs emanate from fluvial gravels; beside a river; etc.)	Columbia River Fault along eastern margin of regional extension complex.	5
B.	**Exploration Uncertainty (Risk)**		2.71
B.1	Degree of identification of resources/reserves	low	3
B.2	Likelihood of covering Resource with concession	Likely possible. Halcyon near mining titles.	4
B.3	Expected authorization date	Unknown. No geothermal tracts nearby.	0
B.4	Specific timing of exploration (2 + 2 years, BC 8 years, etc.)	5-7yr, as soon as permits can be put in place	3
B.5	Degree of previous exploration (can be good or bad)	Geoscientific information exists. Geothermometry studies exist. TG and heat flow data known for general area.	2
B.6	Surface Operational capacity (enough stable area for drilling and facilities planned?)	Likely	5
B.7	Exploration to exploitation (Difficult to easy)	Many unknowns but no high risk uncertainty.	2
C.	**Environmental Issues**		2.00
C.1	Protected areas (type and classification)	potential proposed transmission/piping crosses Ungulate Winter Range no harvest zone.	2
C.2	Endangered species	potential proposed transmission runs thru Southern Mountain Caribou and Snow Ramble occurrences.	2
C.3	Geothermal surface features	Nearest hot springs ~10km from potential resource area. 3 other hot springs within ~15 km. Favourable for tourism.	2
C.4	Other	Potential transmission/piping line crosses fish bearing streams.	2
D.	**Geothermal Area - Bidding and/or type of land holding (private/gov/lease/etc.)**		2.33
D.1	Bidding Area	No geothermal tracts nearby. Permission to use Crown land is obtained by application under the Land Act (LA); target would be lower temperature < 80°C resource.	3
D.2	Electrical generation potential? competition or collaboration possible from Companies present	Not favourable economics, KWL report	1
D.3	Other claim rights(Mining and/or Oil)	several mineral/coal titles in the area.	3

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Upper Arrow Lake	
	Nearest community name:	Revelstoke/Nakusp	
	Nearest large community:	Kelowna	
	Topographic map sheets (name and code) :	St. Leon Creek, 082K05	
	Geological map sheets (name and code)	82K.041	
E.	**Market**		3.50
E.1	Potential commodities for direct use applications	closest communities Revelstoke and Nakusp, and Halcyon resort.	3
E.2	Political stability and community relationship to development	stable, but development favourability unknown. Already 2 resorts (Halcyon and Nakusp) may be potential for collaboration or unwanted competition.	3
E.3	Time Limits? (Business agreements, Operating/generating-by deadlines?)	none known	3
E.4	Renewable energy "green value" for potential development	Nearby communities open to favourable green development	5
F.	**Transmission Line Infrastructure**		0.50
F.1	State of the Infrastructure	closest substation is 28 km away	1
F.2	Transmission route (distance, terrain and costs)	28 km of new 69 kV transmission/piping. Flat conditions along lake, but steep, treed terrain in St. Leon creek.	1
F.3	Wheeling power	n/a	0
F.4	Transmission providers	n/a	0
G.	**Laws governing direct-use renewable energy sources**		3.43
G.1	General Criteria of the Geothermal Law	important aspect is the temperature criteria; under 80 C Crown Land Tenure; above geothermal law.	3
G.2	General Criteria of the water resources law	need a water use licence	3
G.3	Direct sales possible	yes, with a licence	3
G.4	Carbon credits	BC Carbon Registry (new, in place 2016), Carbon Tax	4
G.5	Lease time and ability to renew or extend exploration licence	could be done under geothermal/Land Act tenure.	3
G.6	Issues (and timing) related to conversion from exploration to exploitation	If done under a geothermal lease specific work program is required.	3
G.7	Time frame for exploitation licence	Crown land tenure takes weeks to months, depending on the length of tenure requested; lease up to 30 years	5
H.	**Community Issues**		3.00
H.1	Indigenous Law and Indigenous Development Areas	within Ktunaxa territory (BCTC stage 4)	1
H.2	Land claims	within Okanagan Nation Alliance (Syilx), Secwepemc, Sinixt asserted territories	1
H.3	Community action	no FN communities very nearby. Nakusp community plan "The Hot Springs resource is enhanced, protected and economically sustainable"	5
H.4	Surface Rights	treaty and crown land	3
H.5	Visual considerations	logging areas and roads nearby. Halcyon resort area. Hydro-electric reservoir area.	5
H.6	Tourism	Halcyon, Nakusp hot springs are commercial tourist destination. 4 additional non-commercial hot springs are in the area. Large tourist industry due to proximity to Revelstoke and variety of outdoor recreational activities available.	3
H.7	Traditional use area: trapping, hunting, food and medicinal plants, fishing activities	Ktunaxa Nation Council, Okanagan Nation Alliance, Secwepemc Nation	3
H.8	Traditional use area: Community sacred site, gathering place or event sites	Ktunaxa Nation Council, Okanagan Nation Alliance, Secwepemc Nation	3

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Upper Arrow Lake	
	Nearest community name:	Revelstoke/Nakusp	
	Nearest large community:	Kelowna	
	Topographic map sheets (name and code) :	St. Leon Creek, 082K05	
	Geological map sheets (name and code)	82K.041	
H.9	Traditional use area: archeology sites and other areas of significance	Ktunaxa Nation Council, Okanagan Nation Alliance, Secwepemc Nation	3
I.	**Water rights**		5.00
I.1	availability for proposed development	no existing water licence within ~10 km of potential resource area	5
I.2	availability for drilling	no existing water licence within ~10 km of potential resource area	5
J.	**Engineering**		1.60
J.1	Development proposal and design	none underway	0
J.2	Construction issues	Remote, steep mountainous terrain, limited existing access via logging roads.	1
J.3	Transportation issues	Limited access via existing unpaved roads in St. Leon Creek valley and paved road to Nakusp substation.	1
J.4	Architectural Issues (blend/hide into environment? Local styles? Etc.)	none known	3
J.5	Special construction issues (heat exchanger & full injection)	none known	3
K.	**Non electrical infrastructure (roads and habitation)**		3.40
K.1	Nearest large community > 50,000	Kelowna	4
K.2	nearest community and size	Revelstoke, Nakusp	2
K.3	Nearest road and condition	unpaved existing logging road	3
K.4	Current access conditions (restrictions)	unpaved road access to potential resource area. Provincial Park nearby.	3
K.5	Terrain and distance factor for road building	no requirements for new roads	5
L.	**Development Finance**		0.00
L.1	Development value (greenhouses; tourism; heating; etc.)		0
L.2	Market price for similar commodities not using direct-use heat		0
L.3	Green power premium for commodity?		0
L.4	Commodity price		0
L.5	Marketing implications		0
L.6	Estimated size of resource		0
L.7	Are there any green use incentives?		0
L.8	Grants		0
L.9	Tax holidays		0
L.10	Tax relief		0
L.11	Loan guarantees		0
L.12	Royalties/Fees		0
L.13	General idea of royalties		0
L.14	Private land owner or government land		0
L.15	Tax rate in the country		0
L.16	Transmission Tariffs		0
M.	**Maps**		5.00
M.1	Regional topographic map showing population centres, roads and other infrastructure including electrical grid and nearest substation and/or generating station. (1:500,000?)		5

	GEOTHERMAL DECISION MATRIX WORKSHEET	Comments	Numerical favourability index
	AREA OF INTEREST:	Upper Arrow Lake	
	Nearest community name:	Revelstoke/Nakusp	
	Nearest large community:	Kelowna	
	Topographic map sheets (name and code) :	St. Leon Creek, 082K05	
	Geological map sheets (name and code)	82K.041	
M.2	Regional map showing land tenure in area – geothermal concessions, mining concessions, private land holds, public or national lands (parks) (1:500,000?)		5
M.3	Regional geological map (1:250 or 500,000?)		5
M.4	Detailed geological map of the immediate area of the concessions (1:50,000 or 100,000)		5
N.	**Other issues and considerations**		2.67
N.1	Spatial concentration of potential customers	Revelstoke (pop 7000), Nakusp (pop 1500)	4
N.2	Distance to market for prospective commodities	Kelowna	3
N.3	Costs to potential customers to receive Direct-use benefits	no subsidies	1

OVERALL COMMENTS/ASSESSMENT	Potential for development but area is somewhat remote with minimal previous exploration of any type.

APPENDIX E:

Summary of Community Survey Responses

(please contact Geoscience BC for Appendix E contents)

APPENDIX F:
Geochemistry of Hot Springs

APPENDIX F: Hot springs Geochemistry

This Appendix includes an updated compilation of hot springs in Western Canada and especially British Columbia. The information is based on public data compilation published online on the ArcGIS website under 'Canada Geothermal' , which in turn is initially based on the 1992 Geothermal Resources of British Columbia map by Fairbank and Faulkner (1992). Significant information was added to the data courtesy of Polaris Infrastructure Corp. Detailed data review and corrections were done by Woodsworth. The authors consider this latest version to be the most comprehensively updated hot spring public data available since the 1992 map. Going forward, the updated information will be continued to be hosted, and updated as more public information becomes available, on the ArcGIS online map.

The information in this compilation should not be used for recreation purposes. The authors are not responsible for any individuals using the coordinates listed as a targets location. Instead, the book Hot Springs of Western Canada 3rd edition (Woodsworth and Woodsworth (2014) should be consulted for directions on how to reach most springs.

- Due to the nature of the requirements of the free hosting ArcGIS, various considerations had to be taken into effect in the original data compilation listing. For example, conversion into CSV file format, characters used, and size had to be specifically planned. Some of these decisions were maintained with this data compilation for future continuity and the ability to maintain these options for other users. The current compilation can be easily expanded by others with customized data as they see fit.
- The following considerations were taken into account in the compilation of this data:
- For almost all springs in southern British Columbia, coordinates are based on visits by the authors and on data in Woodsworth and Woodsworth (2014) and Woodsworth (unpublished data). Where more than one spring is present at a given location, we have taken the one with the largest flow, the highest temperature, or high highest Si value, whichever is appropriate.
- Location data for springs not visited by the authors have been checked, where possible, against published maps, reports, and GPS coordinates from trusted sources. However, in some cases locations could be considerably inaccurate. For some springs listed by Fairbank and Faulkner (1992) we have a general location at best, and some of these may not even exist. Each of the Fairbank and Faulkner map locations has a special column in the spreadsheet with a Sxx designation.
- Naming is based on latest location name. Other common and or older names are included in brackets.
- Some springs have several sources separated by several hundred metres. We have treated each of these individually, based on unique characteristics for each location. For example the two hot spring adjacent to Meager hot springs (No Good and Placid), although geochemically related, are mentioned separately due to their unique name, location and historical reporting. While Shovelnose warm spring for example has a second seep that is 500 metres downstream listed under the same location as the main spring due to it continued expression and relation to the main spring data. As another example, Talheo has two main sources 400 metres apart. In this case, we use the location for the northern (hottest) spring. Any suggestions and corrections are more than welcomed for the updating future online versions maintained by the authors.

- Temperatures are those that were measured when samples were collected for analysis. They are not necessarily the highest reliable temperatures measured.
- In references where total and dissolved results are listed, totals were used.
- For springs where both field and laboratory data were available for parameters such as pH and total dissolved solids (TDS), the spreadsheet lists the values obtained in the field.
- Flow rates are notoriously difficult to obtain. We list the best estimates, which may be highly inaccurate. In some cases these are for the total combined flow in a spring system (e.g., all springs at Meager), but for most, references are unclear if it is for the entire system.
- Review comments for suspect data issues and or considerations made from private data sources.

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TABLE F1: Summary of hot spring geochemistry by hot spring name

APPENDIX F: Hot Spring Geochemistry

Name	Lat	Long	Temp (C)	pH	Conductivity (uS/cm)	Eh (mV)	TDS	SiO2	Na	K	Ca	Mg	Cl	Li	SO4	HCO3	CO3	F	Br	B	I	NO3	H2S
Ahousat (Flores Island)	49.26988	-126.07536	25.0	8.60				50.60	34.90	0.400	2.00	0.050	8.200	0.050	12.40	54.60		0.960					
Ahousat (Flores Island)	49.26988	-126.07536	22.7	10.05		-133	156.0	18.90	42.50	0.200	1.91	0.120	10.100	0.000	11.72	35.70	33.60	0.980	0.010	0.050			
Ahousat (Flores Island)	49.26988	-126.07536	22.0	9.50			144.0	36.40	36.80	0.400	1.80	0.100	9.900	0.010	11.60	47.00						0.470	
Ainsworth	49.735833	-116.910833	38.6				1766.2	66.90	290.10		150.00	13.800	62.500		37.60	1144.00							
Ainsworth	49.735833	-116.910833	47.5	6.34				144.00	233.00	20.800	151.00	4.900	42.500	0.660	48.80	979.70		3.640					
Ainsworth	49.735833	-116.910833	45.0	7.00				138.00	230.50	20.300	163.00	5.100	43.200	0.640	50.20	1029.00		3.520					
Ainsworth	49.735833	-116.910833	44.4				800.0	140.00	215.00	1.200		7.500	45.000										
Ainsworth	49.735833	-116.910833	45.0	6.50			1739.0	130.00	243.00	20.900	163.00	5.400	46.700	0.682	58.00	1071.00							
Ainsworth	49.735833	-116.910833	47.5	6.33			1192.0	117.00	219.00	18.600	83.80	0.409	52.000	0.648	-2.00	698.00		1.470		0.443			
Aiyansh (Zolzap)	55.140950	-129.35316	54.7	7.85				99.90	176.00	7.100	3.83		109.000		33.30	205.00							
Aiyansh (Zolzap)	55.140950	-129.35316	54.6	8.64	825			98.90	158.00	6.030	3.92		114.000	0.279	12.39	131.00		8.980		0.516			
Albert Canyon	51.133333	-117.750000	26.0	7.39				20.80	34.00	2.000	49.10	12.900	14.200	0.542	24.90	251.00		0.640					
Albert Canyon	51.133333	-117.750000	25.7	7.70			356.0	43.20	33.90	3.100	53.10	13.200	15.400	0.567	20.50	174.00							
Angel (KLO)	49.797440	-119.341030	22.7	6.40			1358.0	122.00	141.00	6.400	196.00	26.600	3.800	0.153	45.50	815.00							
Asseek	51.950000	-126.716667																					
Atlin	59.404000	-133.575310	28.8	7.10			543.0	32.90	3.40	0.900	74.50	20.200	0.000	0.000	32.00	289.00							
Atlin	59.404000	-133.575310	29.0	8.23					3.40	0.700	67.00	18.500	0.200		12.80	150.00							
August Jacob's	49.88459	-122.258510	49.0				367.0	54.00	3.00		32.00	41.000	39.000		162.00	36.00							
Barnes Lake (Paradise)	56.668610	-131.883800	27.0																				
Bell Island	55.983333	-131.566667	60.0																				
Bella Coola	52.383333	-126.766667																					
Bishop Bay	53.466667	-128.837160	44.0				400.0	65.00	92.00		18.00	0.300	32.000		179.00	4.00							
Blue River	59.650000	-129.683333																					
Brigham	51.000000	-122.000000	8.0	6.83				45.10	196.00	12.200	414.00	228.000	9.500	0.219	198.00	2688.00		0.210					
Brim River	53.513450	-128.364080	38.0				281.0		43.00		17.00	12.000	52.000		78.00	40.00							
Broken Skull	62.750000	-128.130000	45.0					56.00	52.00	33.800	140.00	50.200											
Brooks Peninsula	50.201389	-127.784722																					
Buhl Creek	49.964110	-116.026820	32.5	8.15		+151	243.7	26.00	59.00	2.200	7.20	0.390	10.800	0.140	46.00	92.00							
Buhl Creek	49.964110	-116.026820	31.5	8.69	274		202.0	54.50	51.20	1.740	7.27	0.476	11.000	0.127	36.40	61.50		4.539					
Burton	54.951170	-129.854110	45.0	7.40																			
Cache Creek Cabin	64.650000	-129.210000																					
Canoe Creek	51.461570	-122.068470	20.9	6.98			509.0	13.10	3.63	0.826	92.80	35.900	0.025		7.30	349.00		0.141					
Canoe River	52.621520	-118.969010	60.0	7.07				85.80	263.00	26.600	25.70	0.600	265.000	0.740	200.00	91.50		7.200					
Canoe River	52.621520	-118.969010	57.0	7.38				71.50	290.00	27.700	26.00	0.600	288.000	0.818	209.00	94.50		7.800					
Canoe River	52.621520	-118.969010	67.2	7.97	1523			64.93	306.00	30.900	30.70	0.774	318.000	0.813	227.00								
Canoe River	52.621520	-118.969010	60.9	7.30	1442			79.93	318.00	33.700	25.20	0.601	316.000	0.802	219.00								
Canoe River	52.621520	-118.969010	27.6	7.78	526			26.79	106.00	11.900	15.40	0.613	108.000	0.279	79.90								

APPENDIX F: Hot Spring Geochemistry

Name	Al	As	Ba	Be	Bi	Cd	Co	Cr	Cu	Fe	Hg	Mn	Mo	Ni	P	Pb	Rb	Sb	Se	Sr	Si	Ti	Zn	Discharge (L/s)	'92 Geothermal Map No.	Reference	Comments
Ahousat (Flores Island)		0.0100										0.0020								0.01				1.58	S84	Souther 1976	Coordinates from Woodsworth (2014)
Ahousat (Flores Island)	0.030		0.083						1.910	0.050										0.01				0.20		Philips 1994	
Ahousat (Flores Island)										0.017										0.01			0.003			Grasby 2000	
Ainsworth																								3.80	S98	Souther 1973	
Ainsworth		0.0200										0.4400								0.60				1.27		Souther 1976	37a
Ainsworth		0.0100										0.4500								0.60				1.89		Souther 1976	37b
Ainsworth										0.800										1.20			0.010			Desrochers 1992	
Ainsworth										0.021		0.4870								1.40			0.024			Grasby 2000	
Ainsworth																								1.00		Geoscience BC 2016-xx	(2007 sample) Polaris Infrastructure kind permission
Aiyansh (Zolzap)																								<1	S21	Clark 1985	Coordinates from Woodsworth (unpub notes)
Aiyansh (Zolzap)																								3		Geoscience BC 2016-xx	(2007 sample) Polaris Infrastructure kind permission
Albert Canyon		0.0040										0.0020								0.84				6.30	S56	Souther 1976	
Albert Canyon									0.004	0.064		0.0040								0.21			0.003	0.20		Grasby 2000	
Angel (KLO)									0.007	2.160		0.5820								1.70			0.005	<1		Grasby 2000	Coordinates from Woodsworth 2011 notes
Asseek																									S46		
Atlin										0.020		0.0100								0.20					S4	Grasby 2000	Coordinates from Woodsworth (unpub. Notes)
Atlin																										Crandaall & Sadlier Brown 1997	
August Jacob's																									S88	Souther 1973	Na should be 30? Small flow. Coordinates from Woodsworth 2013 notes
Barnes Lake (Paradise)																										Woodsworth 2014	Yes, it's on the Alaska side...
Bell Island																									S20		Yes, it's on the Alaska side...
Bella Coola																									S42		Warm
Bishop Bay																									S30	Souther 1973	
Blue River																									S105		
Brigham		0.0010										0.0100								0.80					S54	Souther 1976	
Brim River																									S33	Souther 1973	
Broken Skull																								35		NWT 2010	
Brooks Peninsula																										Woodsworth 2014	
Buhl Creek									0.000			0.0005								0.10						Allen 2006	Coordinates from Woodsworth (2014)
Buhl Creek		0.0046																						5		Geoscience BC 2016-xx	(2008 sample) Polaris Infrastructure kind permission
Burton																										Woodsworth 2014	
Cache Creek Cabin																										NWT 2010	
Canoe Creek																								3	S53	Geoscience BC 2016-xx	(2007 sample) Polaris Infrastructure kind permission. Coordinates from Woodsworth
Canoe River		0.0400										0.0200								0.20					S45	Souther 1976	50a
Canoe River		0.0400										0.0300								0.24						Souther 1976	50b
Canoe River																					30.30					Ghomshei 2007	Vent 1 – North pool group
Canoe River																					37.30					Ghomshei 2007	Vent 2 – Individual very hot mud pot in valley
Canoe River																					12.50					Ghomshei 2007	Vent 3 – Stream combining all north zone springs

APPENDIX F: Hot Spring Geochemistry

Name	Lat	Long	Temp (C)	pH	Conductivity (uS/cm)	Eh (mV)	TDS	SiO2	Na	K	Ca	Mg	Cl	Li	SO4	HCO3	CO3	F	Br	B	I	NO3	H2S
Canoe River	52.621520	-118.969010	7.8	7.80	58			4.48	2.00	2.000	11.90	0.816	0.050	0.015	4.50								
Canoe River	52.621520	-118.969010	19.4	8.08	282			18.28	58.70	6.700	10.00	0.491	52.600	0.154	40.50								
Canoe River	52.621520	-118.969010	50.7	8.03	1580			45.21	293.00	25.000	27.90	0.907	310.000	0.747	220.00								
Canoe River	52.621520	-118.969010	44.3	8.14	1156			46.71	233.00	22.600	28.20	1.070	244.000	0.612	184.00								
Canoe River	52.621520	-118.969010	64.4	6.01	1376			64.29	281.00	25.300	25.90	0.610	266.000	0.722	219.00								
Canoe River	52.621520	-118.969010	5.0					4.29	2.00	2.000	12.40	2.620	9.800	0.015	9.80								
Canyon Lake	51.300430	-125.643200	43.0	6.44			4400.0	90.40	819.00	41.900	276.00	25.700	615.000	1.370	1400.00	371.00		0.601		5.320			
Canyon Lake	51.300430	-125.643200	44.9	6.40	5030		3930.0	94.20	891.00	41.900	240.00	27.900	630.000	1.360	1610.00	387.00		0.882		12.300			
Cantung	61.920000	-128.250000	41.0					58.00	47.00	1.240	7.60	1.200											
Cantung North	62.120000	-128.420000	32.0					21.00	0.80	0.700	19.00	12.900											
Carcajou R / Magel Lake	65.280000	-127.750000																					
Cave and Basin	51.169417	-115.591800	29.4				1107.0				217.00	39.000				140.00							
Cave and Basin	51.169417	-115.591800	35.0				1905.0				400.00	71.000			1120.00	175.00							
Cave and Basin	51.169417	-115.591800	34.4	7.10				31.00								146.00							
Cave and Basin	51.169417	-115.591800	30.0					23.40	6.00	4.500	1028.00	39.200	10.000		580.00	140.00							
Cave and Basin	51.169417	-115.591800	31.0					27.00	5.10	3.800	1015.00	42.800	5.000		559.00	153.00							
Cave and Basin	51.169417	-115.591800	30.0					27.00	5.50	4.500	1208.00	45.900	5.400		696.00	126.00							
Cave and Basin	51.169417	-115.591800	29.8	7.00			1162.0	27.00	5.50	4.500	250.00	45.900	5.400	36.000	688.00	126.00						0.080	45.70
Cave and Basin	51.169417	-115.591800	31.8	6.80			2026.0	31.00	7.10	6.300	414.00	75.600	5.400	50.000	696.00	154.00						0.390	14.70
Cedar	50.000000	-119.000000																					
Chief Shakes	56.716940	-132.016940	52.0																				
Choquette (Stikine River Fowler)	56.832460	-131.752720	66.0				880.0																
Choquette (Stikine River Fowler)	56.832460	-131.752720	59.9	7.65			973.0	61.90	220.00	9.130	55.59	0.294	240.000	0.109	184.00	31.89		1.559		0.207			
Clear Creek	49.68608	-121.74177	43.0					58.00	70.00	2.000	24.00		60.000		144.00	30.90	2.20						
Clear Creek	49.68608	-121.74177						46.00	60.00	2.000	23.00												
Clear Creek	49.68608	-121.74177	44.2	8.52				60.70	82.10	2.680	25.80	0.062	36.590	0.142	108.00	70.80		2.090		0.319			
Columbia Lake	50.000000	-115.000000																					
Crawford Bay (Creek)	49.71155	-116.762520	31.5	6.40				21.40	2.20	1.200	4.40	2.800	0.500	0.005	12.80	19.50		0.088					
Crawford Bay (Creek)	49.71155	-116.762520	29.0	6.49			45.8	21.20	2.25	1.159	4.88	2.759	0.092		9.10	19.80		0.089					
Crawford Bay (Creek)	49.71155	-116.762520	27.5	6.75			43.8	20.00	2.27	1.159	4.12	2.759	0.075		8.43	19.80		0.044					
Daly's (Glacier Creek)	49.826667	-122.452222																					
Deca East	64.170000	-128.420000	22.0					38.00	420.00	6.200	285.00	65.000											
Deca West	64.170000	-128.470000	16.0					34.00	200.00	3.640	155.00	58.800											
Dease Lake	58.450000	-130.000000	16.0	8.00																			
Deer River	59.503640	-125.953660	35.0																				
Dewar Creek	49.955130	-116.516252	82.8	6.40				139.00	206.00	10.900	27.90	0.300	54.000	0.907	287.00	149.00							
Ekwi	64.083333	-128.416667	46.0					54.00	5850.00	80.000	260.00	66.000											

APPENDIX F: Hot Spring Geochemistry

Name	Al	As	Ba	Be	Bi	Cd	Co	Cr	Cu	Fe	Hg	Mn	Mo	Ni	P	Pb	Rb	Sb	Se	Sr	Si	Ti	Zn	Discharge (L/s)	'92 Geothermal Map No.	Reference	Comments
Canoe River																					2.09					Ghomshei 2007	Vent 4 – Cold spring above the hot springs
Canoe River																					8.53					Ghomshei 2007	Vent 5 – Stream from north group valley
Canoe River																					21.10					Ghomshei 2007	Vent 6 – Very hot spring from south zone, emerging beneath stump
Canoe River																					21.80					Ghomshei 2007	Vent 7 – South pool water
Canoe River																					30.00					Ghomshei 2007	Vent 8 – Very hot spring above Champagne Bay in south zone
Canoe River																					2.00					Ghomshei 2007	Vent 9 – Kinbasket Lake from mid-lake
Canyon Lake		0.1230																						0.1	S51	Geoscience BC 2016-xx	(2007 sample) Polaris Infrastructure kind permission. Coordinates from Woodsworth
Canyon Lake																								0.2		Geoscience BC 2016-xx	(2008 sample) Polaris Infrastructure kind permission
Cantung																								30		NWT 2010	
Cantung North																								40		NWT 2010	
Carcajou R / Magel Lake																										NWT 2010	
Cave and Basin																								15.8		Souther 1973	Cave
Cave and Basin																								9.5		Souther 1973	Basin
Cave and Basin																										Mazor 1983	
Cave and Basin																										Grasby 2000	Table 1 - Cave, Elworthy 1918
Cave and Basin																										Grasby 2000	Table 1 – Cave, van Everdingen 1972
Cave and Basin																										Grasby 2000	Table 1 – 1994
Cave and Basin									0.005	0.022		0.0120								1.60			0.015			Grasby 2000	Table 2 - Cave
Cave and Basin									0.008	0.036		0.0150								3.10			0.019			Grasby 2000	Table 2 - Basin
Cedar																									S64	Woodsworth 2015 PC	Not a spring (creek water heated for a hot tub).
Chief Shakes																										Woodsworth 2013	
Choquette (Stikine River Fowler)																								46.5	S18	Souther 1973	
Choquette (Stikine River Fowler)																								0.01		Geoscience BC 2016-xx	(2007 sample) Polaris Infrastructure kind permission
Clear Creek											0.60000													0.83	S91	N.S-B.G 1974	C vent
Clear Creek																										N.S-B.G 1974	D vent
Clear Creek		0.0260																						0.08		Geoscience BC 2016-xx	(2007 sample) By kind permission from Polaris Infrastructure. Coords from Woodsworth 2014
Columbia Lake																									S82	Souther 1973	Warm
Crawford Bay (Creek)		0.0200										0.0050								0.20					S99	Souther 1976	Coordinates from Woodsworth (2014)
Crawford Bay (Creek)																								1		Geoscience BC 2016-xx	(HS1 2007 sample) Polaris Infrastructure kind permission
Crawford Bay (Creek)																								1		Geoscience BC 2016-xx	(HS2 2007 sample) Polaris Infrastructure kind permission
Daly's (Glacier Creek)																										Woodsworth PC	Based on highly inaccurate late nineteenth century prospector map.
Deca East																								7		NWT 2010	
Deca West																								<2		NWT 2010	
Dease Lake																									S103		
Deer River																									S6		Coordinates from Woodsworth (unpub)
Dewar Creek																									S96	Grasby 2000	
Ekwi																								30		NWT 2010	

APPENDIX F: Hot Spring Geochemistry

Name	Lat	Long	Temp (C)	pH	Conductivity (uS/cm)	Eh (mV)	TDS	SiO2	Na	K	Ca	Mg	Cl	Li	SO4	HCO3	CO3	F	Br	B	I	NO3	H2S
Elaho River	50.450000	-123.550000	8.0	7.40																			
Elwyn Creek	57.772060	-130.745630	25.0	7.26				167.00	662.00	45.000	74.30	101.000	38.900	0.860	0.50	2449.00		0.350					
Elwyn Creek	57.772060	-130.745630	19.5	6.19	1805	238	2005.0	83.40	345.00	29.000	71.80	60.600	36.600	0.350	1.02	1374.00		0.310		0.960			
Elwyn Creek	57.772060	-130.745630	29.0	6.06	2300	166	3083.0	118.00	501.00	41.000	122.00	102.000	68.300	0.530	1.93	2126.00		0.190		1.340			
Elwyn Creek	57.772060	-130.745630	36.0	6.01	2780	137	3639.0	134.00	659.00	49.000	126.00	104.000	51.000	0.660	0.62	2512.00		0.250		1.730			
Elwyn Creek	57.772060	-130.745630	35.8	6.44			2370.0	135.00	665.00	45.500	128.00	111.000	38.900	0.837	1.55	2670.00		0.129		1.920			
EMR Seep	50.105000	-123.367500	17.0	5.50			2500.0	16.80	567.00	6.900	330.00	3.600	394.000	0.120	1218.00	15.50		1.480					
EMR Seep	50.105000	-123.367500	17.5	5.60			2800.0	16.60	606.00	7.200	355.00	3.700	439.000	0.120	1339.00	14.30		1.410					
EMR Seep	50.105000	-123.367500	20.5	8.40			2686.0	18.00	489.00	8.200	402.00	1.000	489.000	0.200	1260.00	13.40	2.40		0.260	2.100			
Eucott Bay	52.45550	-127.311380	54.0	7.54				62.70	922.00	21.200	300.00	6.800	1680.000	0.258	352.00	39.00		2.760					
Eucott Bay	52.45550	-127.311380	41.5	7.52				58.30	882.00	21.300	286.00	6.500	1600.000	0.239	334.00	40.10		2.640					
Fair Harbour	50.066667	-127.083333																					
Fairmont	50.328000	-115.844000	48.9	6.80				38.00								713.00							
Fairmont	50.328000	-115.844000	45.7	6.80	2480			38.00	31.30	6.200	484.80	105.200	40.600		1010.70	710.20		1.500				0.300	
Fairmont	50.328000	-115.844000	45.9	6.05	2360	+330		31.00	32.10	5.900	430.70	113.200	33.100	0.049	985.60	714.20					0.008	0.200	
Fairmont	50.328000	-115.844000	48.9	7.00	2430			34.10	31.10	5.600	472.80	112.200	52.000		991.60	700.20		0.810					
Fairmont	50.328000	-115.844000	46.7	6.25		+468	2276.9	32.90	29.00	5.500	451.00	107.000	34.000	0.044	929.00	685.00							
Fairmont	50.328000	-115.844000	31.6	6.80	2530			35.30	31.70	6.800	480.80	110.200	44.100		1014.70	709.20		1.300				0.400	
Fairmont	50.328000	-115.844000	32.0	6.30	2450	+412		32.00	33.00	6.100	413.60	115.200	34.600	0.053	897.40	704.10					0.006	0.100	
Fairmont	50.328000	-115.844000	42.2	6.80	2050			27.30	23.70	4.400	372.50	88.100	33.000		775.00	627.80		0.980				0.400	
Fairmont	50.328000	-115.844000	34.8	6.10	1950	+416		24.00	22.50	4.300	330.40	88.100	25.000	0.037	682.80	585.70					0.002	0.300	
Fairmont	50.328000	-115.844000	41.8	6.80	1800			21.00	19.90	3.600	314.40	83.100	27.000		628.70	559.60		0.580				0.300	
Fairmont	50.328000	-115.844000	8.5	8.25	220	+420		3.70	0.80	0.400	23.00	14.000	<.0.1		10.00	134.00					0.005	0.200	
Fairmont	50.328000	-115.844000	4.8	8.30	271			6.40	0.60	0.400	31.00	17.000	0.200		11.00	165.00		0.070				0.400	
Fairmont	50.328000	-115.844000	46.6	6.13	2410		2210.0	28.70	30.00	5.430	433.00	105.000	35.200	0.037	898.00	687.00		0.206					
Flat Fruit	61.670000	-127.580000	11.0					43.00	24.00	5.980	470.00	49.000											
Fording Mountain	49.96880	-114.89803	24.7	7.10	3710	-176		16.00	344.70	16.800	345.60	95.200	305.600		1432.80	207.40			0.600		0.098	0.050	
Fording Mountain	49.96880	-114.89803	25.9	7.12	3710	-246		14.00	344.70	16.600	375.70	95.100	305.600		1972.60	245.50			0.500		0.080	0.100	
Fording Mountain	49.96880	-114.89803	20.5	7.15		-236	3051.0	16.80	423.00	18.600	375.00	104.000	355.900	0.921	1483.00	268.70							
Fording Mountain	49.96880	-114.89803	20.5	7.20			3051.0	16.80	423.00	18.600	375.00	104.000	356.000	0.921	1483.00	269.00							
Fosthall	50.383333	-117.933333																					
Franklin	51.150000	-125.516667																					
Frizzell	54.203110	-129.874710	46.0	7.88				46.20	100.00	3.000	139.00	0.400	14.400	0.005	512.00	15.60		0.640					
Frizzell	54.203110	-129.874710	40.4	7.56	964			36.70	79.50	2.340	134.00	0.717	13.300		443.00	22.80		0.469					
Frog River	58.038670	-127.300500																					
Fry Creek	50.083333	-116.750000																					
Goat Harbour	53.356830	-128.890170	44.0				8640.0	59.00	81.00		22.00	0.300	24.000		174.00	2.00							

APPENDIX F: Hot Spring Geochemistry

Name	Al	As	Ba	Be	Bi	Cd	Co	Cr	Cu	Fe	Hg	Mn	Mo	Ni	P	Pb	Rb	Sb	Se	Sr	Si	Ti	Zn	Discharge (L/s)	'92 Geothermal Map No.	Reference	Comments
Elaho River																									S63		
Elwyn Creek		0.0020										0.0020								0.28				2.5	S12	Souther 1976	
Elwyn Creek	0.140	0.0027	0.116					0.004		1.060		0.0320	0.02						0.0008	0.38		0.002		0.3		Piteau 1988	Vent #1
Elwyn Creek	0.160	0.0038	0.197					0.004		1.010	0.00010	0.1400							0.0020	0.63				0.3		Piteau 1988	Vent #2
Elwyn Creek	0.170	0.0081	0.295							2.500	0.00005	0.0680	0.02					0.070	0.0007	0.68				0.1		Piteau 1988	Vent #5
Elwyn Creek		0.0060																						0.3		Geoscience BC 2016-xx	(2007 sample) Polaris Infrastructure kind permission
EMR Seep																				3.24						Ryder 1983	Original seep
EMR Seep																				3.51						Ryder 1983	304-2 drill hole
EMR Seep	0.560	0.2000	0.001	0.200	0.002	0.020	0.008	0.019	0.003	0.060	0.08000	0.0200	0.02	0.01	0.1	0.080		0.090	0.0800				0.005			Dellechaie 1984	
Eucott Bay		0.0400										0.0600								4.32				7.6	S39	Souther 1976	44a. Coordinates from Woodsworth (2004, unpub)
Eucott Bay		0.0600										0.0900								3.84				2.5		Souther 1976	44b
Fair Harbour																									S57		
Fairmont																									S77	Mazor 1983	
Fairmont																										Allen 2006	van Everdingen 1969, 1972. FA5
Fairmont									0.017											3.60						Allen 2006	van Everdingen 1969, 1972. FA6
Fairmont									0.012	0.030		0.0370											0.062			Allen 2006	van Everdingen 1969, 1972. FA10
Fairmont										0.027		0.0380								3.51			0.069			Allen 2006	van Everdingen 1969, 1972. FA10-2
Fairmont																										Allen 2006	van Everdingen 1969, 1972. FB5
Fairmont																				3.50						Allen 2006	van Everdingen 1969, 1972. FB6
Fairmont																										Allen 2006	van Everdingen 1969, 1972. FC5
Fairmont									0.015	0.080		0.0450								2.60						Allen 2006	van Everdingen 1969, 1972. FC6
Fairmont																							0.039			Allen 2006	van Everdingen 1969, 1972. FC10
Fairmont																				0.10						Allen 2006	van Everdingen 1969, 1972. FD6
Fairmont									0.012	0.030		0.0070														Allen 2006	van Everdingen 1969, 1972. FD10
Fairmont																								0.4		Geoscience BC 2016-xx	(2008 sample) Polaris Infrastructure kind permission
Flat Fruit																								<3		NWT 2010	
Fording Mountain																				6.50					S101	Allen 2006	van Everdingen 1969, 1972. FMa
Fording Mountain																				6.20						Allen 2006	van Everdingen 1969, 1972. FMb
Fording Mountain									0.011	0.083		0.0140								16.80			0.003			Allen 2006	van Everdingen 1969, 1972. FMb-2
Fording Mountain																										Grasby 2000	
Fosthall																									S70		
Franklin																									S52		
Frizzell		0.0040										0.0020								0.84					S25	Souther 1976	Coordinates from Woodsworth 2014
Frizzell																								2.5		Geoscience BC 2016-xx	(2007 sample) Polaris Infrastructure kind permission
Frog River																									S104		
Fry Creek																									S76		
Goat Harbour																									S31	Souther 1973	

APPENDIX F: Hot Spring Geochemistry

Name	Lat	Long	Temp (C)	pH	Conductivity (uS/cm)	Eh (mV)	TDS	SiO2	Na	K	Ca	Mg	Cl	Li	SO4	HCO3	CO3	F	Br	B	I	NO3	H2S
Godlin	64.060000	-128.240000																					
Grizzly Bear	62.670000	-127.920000	44.0					54.00	22.00	23.800	105.00	25.500											
Halcyon	50.518056	-117.900556	53.0				788.0								433.00	48.00							
Halcyon	50.518056	-117.900556	50.5	7.31				81.40	164.00	7.100	52.10	0.600	5.600	0.640	426.00	38.30		7.360					
Halcyon	50.518056	-117.900556	46.5	7.15				84.70	159.50	7.400	50.30	0.600	5.700	0.640	411.00	36.80		7.400					
Halcyon	50.518056	-117.900556	50.8				718.0	71.30	161.00	8.100	57.00		9.000		363.00	48.00							
Halcyon	50.518056	-117.900556	50.3	8.00		-0.185	775.0	37.10	179.00	7.900	60.41	0.660	6.030	0.600	435.00	48.80		7.770		0.050			
Halcyon	50.518056	-117.900556	50.7	7.70			752.0	77.70	159.00	6.900	57.40	0.600	5.700	0.643	396.00	46.00							
Halfway (Kootenay Lake)	50.50465	-117.78627	60.5	8.39				58.30	75.40	3.700	144.00	0.050	1.000	0.069	498.00	10.10							
Halfway (Kootenay Lake)	50.50465	-117.78627	41.8	7.25				48.40	56.00	2.900	108.00	0.800	0.500	0.045	363.00	18.20		3.200					
Halfway (Kootenay Lake)	50.50465	-117.78627	58.9	8.20			805.0	52.80	72.00	3.800	158.00	0.100	4.700	0.062	490.00	19.00		2.200					
Halfway (Kootenay Lake)	50.50465	-117.78627	51.1	8.53			847.0	67.40	101.00	5.340	100.00	0.057	4.070	0.219	405.00	18.60		4.160					
Halfway (Kootenay Lake)	50.50465	-117.78627	52.7	8.39			766.0	67.80	102.00	5.420	97.20	0.097	4.030	0.218	456.00	19.00		4.060					
Harrison	49.306556	-121.796833	63.0				1332.0	59.00															
Harrison	49.306556	-121.796833	60.0				1279.0	74.00															
Harrison	49.306556	-121.796833	63.0	8.25				54.20	350.00	13.000	83.00			0.120	506.00	24.80							
Harrison	49.306556	-121.796833	68.0					107.00	331.00	12.800	80.70	0.050	279.000	0.168	503.00	19.30		2.720					
Harrison	49.306556	-121.796833	61.7					75.90	332.00	12.600	81.50	0.100	275.000	0.168	497.00	21.80		2.720					
Harrison	49.306556	-121.796833	62.4	7.70			1379.0	68.90	355.00	11.700	89.20	0.100		0.164	547.00	19.60							
Harrison	49.306556	-121.796833	68.0	8.09			1750.0	63.50	335.00	9.700	86.70	0.079	337.000	0.159	478.00	17.20		2.279		4.000			
Hartley Bay	53.433333	-129.250000																					
Hole-in-the-Wall	61.700000	-127.280000	47.0					83.00	28.00	0.700	1.20	0.000											
Hoodoo Creek	51.345170	-125.62257	82.5	6.61	6370		3660.0	151.00	1180.00	96.500	56.60	6.100	1340.000	3.670	790.00	26.40		0.159		12.200			
Hoodoo Mt	56.766667	-131.250000																					
Hoosier Ridge Pool	65.380000	-127.570000																					
Hotspring Island	52.575410	-131.442240	76.0					115.00	850.00	63.000	304.00	0.200											
Hudson Hope	55.983333	-122.000000																					
Iskut River	57.082500	-130.361390	74.5	6.95			1760.0	78.09	511.00	26.800	39.40	2.529	153.000	0.594	364.00	711.00	8.41	8.410		4.010			
Job Creek	50.664049	-123.543708	18.8	8.24	620		391.0	14.40	4.54	4.360	110.00	10.800	0.500	0.010	227.00	131.00							
Jones Lake	59.883333	-134.000000	13.0	7.60																			
Jordon Ranch	49.800000	-118.166667	12.0	6.41				40.70	466.00	27.100	137.00	35.200	92.400	1.020	225.00	1404.00		1.620					
Kaslo Creek	49.916667	-117.166667	11.0	6.12				63.80	8.40	1.700	401.00	50.700	0.600	0.005	15.00	1512.00		0.120					
Kaslo Creek	49.916667	-117.166667	6.6	8.10			407.0	10.80	2.19	1.159	112.00	9.479	0.120		22.29	335.00							
Kennedy River	49.083333	-125.583333																					
Khutze Inlet	53.079300	-128.386850	23.0																				
Klekane	53.246140	-128.680960	56.0				8640.0		2523.00	82.000	385.00	179.000	4600.000		717.00	58.00							
Kraus (Clausen Creek)	61.250000	-124.060000	37.0																				

APPENDIX F: Hot Spring Geochemistry

Name	Al	As	Ba	Be	Bi	Cd	Co	Cr	Cu	Fe	Hg	Mn	Mo	Ni	P	Pb	Rb	Sb	Se	Sr	Si	Ti	Zn	Discharge (L/s)	'92 Geothermal Map No.	Reference	Comments
Godlin																										NWT 2010	
Grizzly Bear																								30		NWT 2010	
Halcyon																								2.1	S101	Souther 1973	
Halcyon		0.0010										0.0100								1.24				4.4		Souther 1976	29a
Halcyon		0.0020										0.0100								1.16				1.3		Souther 1976	29b
Halcyon																								2.5		Philips 1994	Elworthy 1923
Halcyon	0.020		0.010							0.010										2.63						Philips 1994	
Halcyon										0.024		0.0110								2.50			0.033			Grasby 2000	
Halfway (Kootenay Lake)												0.0050								2.48				0.4	S68	Souther 1976	30a. Coordinates from Woodsworth (2014)
Halfway (Kootenay Lake)		0.0040										0.0050								1.84				1.3		Souther 1976	30b
Halfway (Kootenay Lake)		0.0060							0.005	0.028		0.0090								4.80			0.033			Grasby 2000	
Halfway (Kootenay Lake)																								1.0		Geoscience BC 2016-xx	(HS1 2007 sample) Polaris Infrastructure kind permission
Halfway (Kootenay Lake)																								0.3		Geoscience BC 2016-xx	(HS2 2007 sample) Polaris Infrastructure kind permission
Harrison																									S92	Souther 1973	Sulphur
Harrison																										Souther 1973	Potash
Harrison																								4.2		N.S-B.G 1974	
Harrison		0.0180										0.0020								0.64				9.5		Souther 1976	56a
Harrison		0.0060										0.0050								0.56				12.6		Souther 1976	56b
Harrison									0.005	0.016		0.0090								1.30			0.003			Grasby 2000	
Harrison		0.0190																						0.08		Geoscience BC 2016-xx	(2007 sample) Polaris Infrastructure kind permission
Hartley Bay																									S28		
Hole-in-the-Wall																											
Hoodoo Creek																								30		NWT 2010	
Hoodoo Mt																								5	S50	Geoscience BC 2016-xx	(2008 sample) Polaris Infrastructure kind permission. Coordinates from Woodsworth
Hoosier Ridge Pool																									S19		
Hotspring Island																										NWT 2010	
Hudson Hope																									S36	Souther 1976	
Iskut River		0.0180																						2		Geoscience BC 2016-xx	(2007 sample) Polaris Infrastructure kind permission
Job Creek																								<3		C. Hickson kind permission	Originally mapped by P. Read early seventies and identified by GW as WS in Aug 2012.
Jones Lake																									S3		
Jordon Ranch		0.0040										0.7300								2.68					S94	Souther 1976	
Kaslo Creek		0.0010										1.9200								0.52					S23		Hot
Kaslo Creek																								3.5		Geoscience BC 2016-xx	(2007 sample) Polaris Infrastructure kind permission
Kennedy River																									S85		
Khutze Inlet																									S35		
Klekane																									S34	Souther 1973	
Kraus (Clausen Creek)																										NWT 2010	

APPENDIX F: Hot Spring Geochemistry

Name	Lat	Long	Temp (C)	pH	Conductivity (uS/cm)	Eh (mV)	TDS	SiO2	Na	K	Ca	Mg	Cl	Li	SO4	HCO3	CO3	F	Br	B	I	NO3	H2S
Lakelse	54.35856	-128.54098	85.0				1109.6	5.60	320.60		46.60	50.200	215.900	10.200	457.20	43.60	2.30	3.300					
Lakelse	54.35856	-128.54098	54.0	7.92				68.20	290.00	9.400	65.50	0.050	193.000	0.131	473.30	21.10		5.540					
Lakelse	54.35856	-128.54098	63.0	7.80			1085.0	134.00	299.00	7.900	76.20	0.100	184.000	0.135	360.00	20.20							
Lakelse	54.35856	-128.54098	70.2	7.07	1237			53.30	200.00	5.580	54.90	0.154	122.000	0.097	330.00	28.40		3.360					
Len King (King Creek)	56.48499	-130.656890	40.0	7.48	3850			145.00	437.00	14.500	413.00	207.000	200.000	0.070	1900.00	1110.00							
Len King (King Creek)	56.48499	-130.656890	33.6	6.85			3420.0	137.00	526.00	16.100	437.00	201.000	205.000	0.239	1310.00	1540.00		0.048		3.260			
Lepine Creek	59.450000	-124.816667																					
Liard	59.43127	-126.10012	52.0				1195.0	57.00					23.000										
Liard	59.43127	-126.10012	50.0	6.50			1177.0	94.10	16.40	10.100	226.00	34.400	16.700	0.092	592.00	180.00							
Lussier (Whiteswan)	50.135200	-115.576900	43.4	7.10				36.00								218.00							
Lussier (Whiteswan)	50.135200	-115.576900	43.4	7.10	5220	-88		36.00	876.70	10.000	145.30	25.000	1404.800		135.30	218.40					0.015	0.005	2.00
Lussier (Whiteswan)	50.135200	-115.576900	43.2	7.07		-51	2937.1	36.60	979.00	10.600	115.00	24.800	1400.000	0.080	148.00	222.00						0.052	32.00
Lussier (Whiteswan)	50.135200	-115.576900	43.3	7.07	5330		497.0	5.04	1.18	0.500	101.00	26.000	0.716		233.00	133.00		0.074					
Lymnae	64.150000	-128.430000	21.0																				
McArthur	63.068333	-135.701944	54.5																				
Meager Creek	50.576667	-123.460000	59.0	6.20				164.00	450.00	47.000	81.00	25.000	675.000	1.200	110.00	468.00							
Meager Creek	50.576667	-123.460000	56.0					201.00	410.00	84.000	78.00	24.500											
Meager Creek	50.576667	-123.460000	58.0					220.00	440.00	91.000	89.00	27.300											
Meager Creek	50.576667	-123.460000	55.0					164.00	450.00	47.000	81.00	25.000	675.000		110.00	468.00							
Meager Creek	50.576667	-123.460000	31.4	6.50				56.00	165.00	23.700	92.00	15.400			25.00	503.00							
Meager Creek	50.576667	-123.460000	30.0	6.80				54.00	248.00	27.000	83.50	17.100			50.00	260.00							
Meager Creek	50.576667	-123.460000	48.5	6.40				80.50	347.00	44.000	92.00	24.800			65.00	450.00							
Meager Creek	50.576667	-123.460000	56.0	6.05				92.00	377.00	46.200	94.00	34.100			170.00	458.00							
Meager Creek	50.576667	-123.460000	56.5	6.15				96.00	410.00	52.000	105.00	40.500			180.00	686.00							
Meager Creek	50.576667	-123.460000	50.0	6.60				102.00	390.00	48.500	92.00	31.000			145.00	595.00							
Meager Creek	50.576667	-123.460000	47.0	7.20			1853.0	172.00	419.00	44.600	77.50	24.700	543.000	1.150	125.00	445.00							
Meilleur	61.130000	-124.900000																					
Mess Creek	57.400670	-130.923620	41.2	6.81				71.50	1186.00	38.200	564.00	77.100	393.000	1.280	1960.00	2074.00		0.290					
Mess Creek	57.400670	-130.923620	41.5	6.96				60.50	290.00	14.800	127.00	18.700	166.000	0.275	405.00	469.40		2.200					
Mess Creek	57.400670	-130.923620	42.5	6.20	2400	-026	1216.0	44.50	190.00	18.000	138.00	20.400	209.000	0.310	150.00	441.00		1.700		13.800			
Mess Creek	57.400670	-130.923620	13.0	6.69	4800	+367	4858.0	51.80	950.00	44.000	361.00	94.700	526.000	1.110	560.00	2243.00		0.380		0.920			
Mess Creek	57.400670	-130.923620	42.5	6.55			16100.0	51.80	352.00	15.500	145.00	19.300	191.000	0.354	386.00	581.00		1.610		0.902			
Middle Spring	51.162250	-115.575300	34.8	7.80																			
Middle Spring	51.162250	-115.575300	22.0	7.20				30.00	5.50	4.600	246.00	48.100	5.400	0.034	688.00	166.00	1195.00					0.060	36.70
Miette	53.129840	-117.772356	49.0				503.0	9.00	50.00	<0.01	86.00	22.000	45.000		115.00	281.00							
Miette	53.129840	-117.772356	49.0				1825.0	116.00	13.00	17.300		65.000			45.00		116.00						
Miette	53.129840	-117.772356	54.4	7.10				65.00								129.00							

APPENDIX F: Hot Spring Geochemistry

Name	Al	As	Ba	Be	Bi	Cd	Co	Cr	Cu	Fe	Hg	Mn	Mo	Ni	P	Pb	Rb	Sb	Se	Sr	Si	Ti	Zn	Discharge (L/s)	'92 Geothermal Map No.	Reference	Comments
Lakelse										18.200					8.2										S26	Souther 1973	Coordinates from Woodsworth 2014 are for large circular pool just west of the highway
Lakelse		0.0060										0.0600								1.68				6.94		Souther 1976	
Lakelse									0.004	0.049		0.0010								4.20			0.005			Grasby 2000	
Lakelse																								2.00		Geoscience BC 2016-xx	(2007 sample) Polaris Infrastructure kind permission
Len King (King Creek)	0.170		0.013							0.500		0.0050								9.48					S106	Piteau 1988	
Len King (King Creek)		0.0044																						2		Geoscience BC 2016-xx	(2007 sample) Polaris Infrastructure kind permission
Lepine Creek																									S10		Warm
Liard																								4.7	S7	Souther 1973	Coordinates from Woodsworth (2014)
Liard									0.007	0.024		0.0170								7.70			0.010			Grasby 2000	
Lussier (Whiteswan)																									S79	Mazor 1983	
Lussier (Whiteswan)																				1.00				4		Allen 2006	van Everdigen 1969, 1972 – LC7
Lussier (Whiteswan)									0.006	0.023		0.0080								1.09			0.016			Allen 2006	LC7-2
Lussier (Whiteswan)																								3		Geoscience BC 2016-xx	(2008 sample) Polaris Infrastructure kind permission
Lymnae																										NWT 2010	
McArthur																										Woodsworth 2013	
Meager Creek																								8.3	S60	N.S-B.G 1974	Main vent
Meager Creek																								6.3		Souther 1976	52a
Meager Creek																								18.9		Souther 1976	52b
Meager Creek																								12.6		Souther 1976	52c
Meager Creek										0.450		0.4500														Hammerstrom 1977	01
Meager Creek										0.500		0.9500														Hammerstrom 1977	03
Meager Creek												0.3200														Hammerstrom 1977	05
Meager Creek										0.150		0.6500														Hammerstrom 1977	06 (GSC1)
Meager Creek										0.300		0.6500														Hammerstrom 1977	17 (GSC1)
Meager Creek												0.3400														Hammerstrom 1977	18
Meager Creek									0.005	0.050		0.2570								2.40			0.003			Grasby 2000	
Meilleur																										NWT 2010	
Mess Creek		0.0040										0.0100								5.64				3.20	S15	Souther 1976	Mess Lake
Mess Creek		0.0260										0.1200								1.32				1.30		Souther 1976	Mess Creek
Mess Creek	0.340	0.0240	0.073									0.1700							0.0007	2.85			0.007	0.50		Piteau 1988	HS
Mess Creek	0.250	0.0006	0.016				0.010	0.005	0.011	7.100	0.00100	0.4200				0.002			0.0002	9.74				0.01		Piteau 1988	Lake Spring
Mess Creek		0.0350																						0.20		Geoscience BC 2016-xx	(2007 sample) Polaris Infrastructure kind permission
Middle Spring																										Mazor 1983	
Middle Spring									0.004	0.035		0.0140								1.60			0.016			Grasby 2000	
Miette																										Souther 1973	33A
Miette																										Souther 1973	33B
Miette																										Mazor 1983	

APPENDIX F: Hot Spring Geochemistry

Name	Lat	Long	Temp (C)	pH	Conductivity (uS/cm)	Eh (mV)	TDS	SiO2	Na	K	Ca	Mg	Cl	Li	SO4	HCO3	CO3	F	Br	B	I	NO3	H2S
Miette	53.129840	-117.772356	51.8	6.90			1828.0	52.20	9.80	14.800	375.00	64.500	4.000	0.083	1168.00	127.00							1.00
Mist Mt	50.547033	-114.891633	33.0	7.50			529.0	24.80	5.30	1.000	111.00	24.800	2.800	0.011	280.00	79.20						0.170	
Moonscape	64.530000	-129.250000	11.0																				
Moore's	62.340000	-128.130000	40.0																				
Morin South	59.966667	-134.216667	14.0	8.20																			
Mount Maldur	50.366667	-118.000000																					
Mountain 1	64.530000	-129.250000	10.0					34.00	80.00	1.600	350.00	102.000											
Mountain 2	64.520000	-129.250000	10.0					34.00	82.00	1.600	390.00	112.000											
Mountain 3	64.630000	-129.220000	9.0					34.00	2.80	0.700	270.00	60.000											
Mountain River / Gayna R	65.420000	-128.130000																					
Mutton Creek	50.000000	-115.666667																					
Nahanni Headwater	62.820000	-128.830000	64.0					109.00	56.00	1.680	2.80	0.000											
Nahanni North	62.370000	-128.670000	58.0					78.00	67.00	1.360	1.90	0.000											
Nakina	59.270670	-132.619500																					
Nakusp	50.29776	-117.67432	54.5	7.50				22.10	72.60	4.200	51.50	0.400	1.300	0.048	262.00	17.60		0.800					
Nakusp	50.29776	-117.67432	53.0	7.06				10.60	84.00	5.000	59.90	0.300	1.500	0.066	300.00	18.00		0.336					
Nakusp	50.29776	-117.67432	57.7	8.15		-0.212		34.10	95.00	5.700	68.71	0.340	2.340	0.060	300.00	30.98		2.320		0.070			
Nakusp	50.29776	-117.67432	55.8	7.90			599.0	62.00	85.50	5.800	68.70	0.300	1.500	0.071	290.00	80.00							5.20
Nakusp	50.29776	-117.67432	48.5	8.32			461.0	54.90	72.00	3.500	50.60	0.650	1.620	0.059	226.00	20.20		2.100					
Nakusp	50.29776	-117.67432	55.2	7.98			546.0	59.80	84.80	4.320	58.00	0.213	1.710	0.061	261.00	16.80		2.250					
Nascall Bay	52.485550	-127.281111	43.0																				
Nash Creek	64.551389	-134.701389	65.0																				
No Good	50.562667	-123.515000	34.5	6.40			1470.0	120.00	320.00	32.000	88.00	16.000	470.000	1.000	110.00	310.00		0.200		2.500			
Ocean Falls	52.366667	-127.666667																					
Octopus Creek	49.736840	-118.076210	48.8	7.56				108.00	143.50	5.600	17.50	1.100	44.200	0.126	128.00	176.30		8.100					
Octopus Creek	49.736840	-118.076210	28.6	7.89			517.0	81.59	127.00	4.809	19.79	1.500	1.240	0.109	121.00	180.00		5.780					
Pebble Creek	50.66785	-123.46068	60.0	8.00				75.50	425.00	14.500	30.00	4.700	100.000	1.200		757.00		5.000					
Pebble Creek	50.66785	-123.46068	59.5	7.90				99.00	415.00	10.000	54.00	5.300											
Pebble Creek	50.66785	-123.46068	53.5	7.70				40.00	410.00	13.800	44.00	6.600	72.000		315.00	992.00							
Pebble Creek	50.66785	-123.46068	59.0	6.85				43.00	396.00	18.200	42.00	6.100	67.000		278.00	992.00							
Pebble Creek	50.66785	-123.46068	50.5	8.00				44.00	418.00	18.900	39.00	7.000	72.000		340.00	1068.00							
Pebble Creek	50.66785	-123.46068	59.0	6.70				60.00	405.00	18.900	32.50	7.000	71.000		385.00	1053.00							
Pebble Creek	50.66785	-123.46068	56.2	6.67	1920		1360.0	77.60	437.00	11.300	39.80	5.170	81.000	0.607	321.00	617.00		10.000		0.900			
Phillips Arm	50.500000	-125.350000																					
Pinter	51.300000	-125.616667																					
Pipestem	49.050000	-125.200000																					
Pitt River	49.696130	-122.708920	57.3	8.17				68.20	212.50	8.200	83.50	0.050	196.000	0.145	362.00	20.50		1.460					

APPENDIX F: Hot Spring Geochemistry

Name	Al	As	Ba	Be	Bi	Cd	Co	Cr	Cu	Fe	Hg	Mn	Mo	Ni	P	Pb	Rb	Sb	Se	Sr	Si	Ti	Zn	Discharge (L/s)	'92 Geothermal Map No.	Reference	Comments
Miette									0.011	0.043		0.0170								12.50			0.004			Grasby 2000	
Mist Mt										0.007		0.0020								0.76			0.008			Grasby 2000	
Moonscape																										NWT 2010	
Moore's																										NWT 2010	
Morin South																									S2		
Mount Maldur																									S65		
Mountain 1																								15		NWT 2010	
Mountain 2																								<3		NWT 2010	
Mountain 3																								25		NWT 2010	
Mountain River / Gayna R																										NWT 2010	
Mutton Creek																									S81		
Nahanni Headwater																								60		NWT 2010	
Nahanni North																								40		NWT 2010	
Nakina																									S107	Woodsworth 2014	Warm
Nakusp		0.0040										0.0050								1.08				3.20	S71	Souther 1976	32a. Coordinates from Woodsworth (unpub) is for source, not pools.
Nakusp		0.0040										0.0200								0.76				3.20		Souther 1976	32b
Nakusp			0.040							0.020										5.34						Philips 1994	
Nakusp										0.021		0.0080								4.70			0.030			Grasby 2000	
Nakusp																								0.13		Geoscience BC 2016-xx	(HS1 2007 sample) Polaris Infrastructure kind permission
Nakusp																								1.00		Geoscience BC 2016-xx	(HS2 2007 sample) Polaris Infrastructure kind permission
Nascall Bay																									S38		
Nash Creek																										Woodsworth 2013	
No Good																									S60B	N.S-B.G 1981	
Ocean Falls																									S37		
Octopus Creek		0.0020										0.1400								0.28					S95	Souther 1976	Coordinates from Woodsworth (unpub)
Octopus Creek																								0.1		Geoscience BC 2016-xx	(2007 sample) Polaris Infrastructure kind permission
Pebble Creek																								1.70	S59	N.S-B.G 1974	
Pebble Creek																								0.95		Souther 1976	
Pebble Creek												0.0900														Hammerstrom 1977	07
Pebble Creek										0.150		0.1000														Hammerstrom 1977	08
Pebble Creek												0.0900														Hammerstrom 1977	12
Pebble Creek										0.150		0.1100														Hammerstrom 1977	13
Pebble Creek		0.1440	0.075							0.180		0.2240														C. Hickson kind permission	2012 Sample
Phillips Arm																									S58		
Pinter																									S49		
Pipestem																									S86		
Pitt River		0.0380										0.0020								0.44				0.44	S90	Souther 1976	

APPENDIX F: Hot Spring Geochemistry

Name	Lat	Long	Temp (C)	pH	Conductivity (uS/cm)	Eh (mV)	TDS	SiO2	Na	K	Ca	Mg	Cl	Li	SO4	HCO3	CO3	F	Br	B	I	NO3	H2S
Placid	50.562667	-123.482000	45.1	5.89			2013.0	138.00	433.00	53.500	114.00	27.600	674.000		174.00	398.00							
Portage Brule	59.630330	-126.905500	44.0				814.0		41.00	34.000	125.00	77.000	64.000		77.00	725.00		0.330					
Prophet River	57.651670	-124.025000	37.0																				
Rabbitkettle	61.950000	-127.180000	21.0					40.00	3.85	4.840	200.00	39.800											
Radium	50.634722	-116.040556	45.5	6.90				45.00								216.00							
Radium	50.634722	-116.040556	45.1	6.80					15.00	3.000	144.10	32.000	10.800		319.10	206.10							
Radium	50.634722	-116.040556	44.0	6.69		+518	827.8	38.60	14.90	3.270	150.00	33.200	13.200	0.040	356.00	217.00							
Ram Bluff	52.450000	-127.240000																					
Ram Creek	50.032900	-115.592760	34.6	7.60	400				2.60	1.300	50.00	15.000	1.700		57.00	155.00						0.500	
Ram Creek	50.032900	-115.592760	36.5	7.68		+481	294.0	21.30	2.40	1.300	49.20	14.500	1.200	0.002	56.00	148.00							
Ram Creek	50.032900	-115.592760	35.5	7.77	348		348.0	21.00	1.76	1.080	48.80	14.300	1.560		49.20	143.00		0.103					
Ray's Mineral Spring	52.100000	-120.000000	11.0	6.87				102.00	138.00	17.600	618.00	109.000	4.000	0.335	0.50	2837.00		0.061					
Red Rock	50.23991	-115.69698	18.3	6.30		+185	1199.3	6.00	10.00	2.400	220.00	59.000	11.900	0.019	379.00	511.00							
Redstone Jct 1	63.530000	-125.700000	15.0					47.00	88.50	2.540	88.00	34.100											
Redstone Jct 2	63.550000	-125.730000	8.0					31.00	5.30	0.480	69.00	35.200											
Redstone North	63.720000	-126.420000	9.0					40.00	12.40	0.920	39.00	34.500											
Redstone South	63.400000	-125.870000	54.0					58.00	49.00	1.460	72.00	21.000											
Riondel	49.759444	-116.861944	30.0					175.00	440.00	60.000		190.000	70.000		190.00								
Riske	51.998430	-122.579390	8.0	7.10				55.00	357.00	8.600	31.00	232.000	7.300	0.157	135.00	2071.00		0.060					
Riske	51.998430	-122.579390	4.9	6.29			2860.0	36.79	376.00	7.400	303.00	254.000	0.090	0.177	112.00	2990.00		0.020		0.191			
Roche-qui-trempe-a-l'eau	63.300000	-123.620000	31.0				12556.0						5226.000		2810.00	184.00		3.000				1.000	
Sculpin	63.940000	-129.310000																					
Sezill (Tawah Creek)	57.68466	-130.76424	43.0	9.18				191.00	476.00	55.600	3.70	132.000	50.200	0.680	0.50	1466.00		0.084					
Sezill (Tawah Creek)	57.68466	-130.76424	45.9	6.71	3005	82	3489.0	144.00	529.00	62.000	171.00	136.000	61.200	0.560	1.78	2455.00		0.160		1.340			
Sezill (Tawah Creek)	57.68466	-130.76424	43.0	6.77	3000	103	3516.0	144.00	529.00	63.000	170.00	138.000	63.200	0.580	1.83	2401.00		0.110		2.160			
Sezill (Tawah Creek)	57.68466	-130.76424	46.0	6.72	2900	129	3033.0	122.00	444.00	54.000	143.00	116.000	58.200	0.480	1.59	2088.00		0.090		1.820			
Sezill (Tawah Creek)	57.68466	-130.76424	45.9	6.42			5230.0	152.00	515.00	54.600	167.00	141.000	52.700	0.732	5.01	2440.00		0.023		2.310			
Sharp Point (Hot Spring Cove)	49.349690	-126.259540	52.0				483.0	59.00	137.00	2.000	20.00	1.000	217.000		47.00								
Sharp Point (Hot Spring Cove)	49.349690	-126.259540	50.5	8.38				52.80	141.20	2.000	17.70	0.050	206.000	0.072	36.00	22.30		1.320					
Sharp Point (Hot Spring Cove)	49.349690	-126.259540	50.3	8.71		-246	524.0	50.10	149.00	2.000	22.70	0.080	224.000	0.050	31.05	38.80	1.30	1.550	1.100	2.290			
Sharp Point (Hot Spring Cove)	49.349690	-126.259540	58.5	7.80			469.0	37.30	143.00	0.170	18.20	0.100	211.000	0.067	36.00	20.90						9.600	8.20
Shearwater (Europa)	53.450530	-128.560520	44.0				1229.0	90.00	259.00	29.000	67.00	5.000	60.000		546.00	167.00							
Sheemahant	51.751944	-126.54667	61.9																				
Shelsay	58.363000	-131.880830																					
Shovelnose Creek	50.084444	-123.279833	27.3	6.80			1666.0	45.00	402.00	75.000	83.00	13.000	787.000	1.300	60.00	199.00		0.500	0.015	3.500			
Shovelnose Creek	50.084444	-123.279833	15.5	5.95			9040.0	70.19	1530.00	235.000	358.00	80.900	2500.000	6.989	179.00	1280.00		0.241		1.880			
Sloquet	49.730120	-122.327110	64.0	8.40				59.00	112.00	3.400	76.00	-0.200	40.000		440.00	14.80							

APPENDIX F: Hot Spring Geochemistry

Name	Al	As	Ba	Be	Bi	Cd	Co	Cr	Cu	Fe	Hg	Mn	Mo	Ni	P	Pb	Rb	Sb	Se	Sr	Si	Ti	Zn	Discharge (L/s)	'92 Geothermal Map No.	Reference	Comments
Placid										0.350		0.7600													S60A	N.S-B.G 1981	
Portage Brule										1.000		0.0800									40.00				S5	Souther 1973	
Prophet River																									S16	Woodsworth 2014	
Rabbitkettle																								<2		NWT 2010	
Radium																									S74	Mazor 1983	
Radium																										Allen 2006	van Everdingen 1969, 1972 – RA1
Radium									0.007	0.031		0.0120								1.60			0.024			Allen 2006	RA 1-2
Ram Bluff																									S40		Warm
Ram Creek																				0.20					S80	Allen 2006	van Everdingen 1969, 1972 – RC7. Coordinates from Woodsworth 2014
Ram Creek												0.0040								0.20			0.005			Allen 2006	RC 7-2
Ram Creek		0.0089																						1.5		Geoscience BC 2016-xx	(2008 sample) Polaris Infrastructure kind permission
Ray's Mineral Spring		0.0040										0.4100								1.16						Souther 1976	
Red Rock									0.000	0.006		0.0006											0.021			Allen 2006	
Redstone Jct 1																								25		NWT 2010	
Redstone Jct 2																								4		NWT 2010	
Redstone North																										NWT 2010	
Redstone South																								120		NWT 2010	
Riondel																										Woodsworth 2014	
Riske		0.0040										0.0200								0.16					S43	Souther 1976	
Riske																							0.100			Geoscience BC 2016-xx	(2007 sample) Polaris Infrastructure kind permission
Roche-qui-trempe-a-l'eau																					24.00			0.05		Souther 1973	
Sculpin																										NWT 2010	
Sezill (Tawah Creek)		0.0060																		0.01				1.9	S13	Souther 1976	
Sezill (Tawah Creek)	0.160	0.0190	0.405					0.004		4.510	0.00006	0.0370							0.0020	1.30				0.3		Piteau 1988	Main vent
Sezill (Tawah Creek)	0.160	0.0180	0.389					0.004	0.007	2.500	0.00005	0.0370								1.24				0.3		Piteau 1988	Mushroom
Sezill (Tawah Creek)	0.170	0.0150	0.342					0.004	0.005	5.070		0.2100							0.0001	1.06				0.3		Piteau 1988	South hotspring
Sezill (Tawah Creek)		0.0140																						2.0		Geoscience BC 2016-xx	(2007 sample) Polaris Infrastructure kind permission
Sharp Point (Hot Spring Cove)																								6.3	S83	Souther 1973	Coordinates from Woodsworth 2014
Sharp Point (Hot Spring Cove)		0.0060										0.0200								0.01				6.3		Souther 1976	
Sharp Point (Hot Spring Cove)	0.020																			0.15				5.0		Philips 1994	
Sharp Point (Hot Spring Cove)										0.015		0.0030								0.17			0.004			Grasby 2000	
Shearwater (Europa)																									S32	Souther 1973	
Sheemahant																								3	S48	Woodsworth 2014	
Shelsay																									S8		
Shovelnose Creek	0.210	0.2000		0.001	0.200	0.002	0.010	0.002	0.005	0.080	0.05000	0.0800	0.01	0.01	0.1	0.050		0.050	0.0500				0.005		S62	Dellechaie 1984	
Shovelnose Creek		0.0340															0.563							0.01		Geoscience BC 2016-xx	(1.5 km seep downstream from spring 2007 sample) Polaris Infrastructure kind permission
Sloquet																								1.67	S89	N.S-B.G 1974	

APPENDIX F: Hot Spring Geochemistry

Name	Lat	Long	Temp (C)	pH	Conductivity (uS/cm)	Eh (mV)	TDS	SiO2	Na	K	Ca	Mg	Cl	Li	SO4	HCO3	CO3	F	Br	B	I	NO3	H2S
Sloquet	49.730120	-122.327110	68.0	8.73				86.90	112.80	3.300	82.50	0.050	49.800	0.030	347.00	10.60		0.730					
Sloquet	49.730120	-122.327110	67.5	8.73				80.30	125.60	3.500	87.70	0.050	58.700	0.033	352.00	12.80		0.800					
Sloquet	49.730120	-122.327110	60.8	8.60			727.0	65.20	114.00	3.100	83.50	0.000	59.700	0.024	375.00	25.80							
Snippaker Creek (Julian Lake)	56.534720	-130.723000																					
Snowshoe Rabbit	49.916667	-118.183333																					
Sphaler Creek	57.04258	-131.24553	48.5	6.59			1360.0	69.90	396.00	16.300	64.80	12.300	63.400	0.372	145.00	963.00		3.890		1.790			
St. Leon	50.43379	-117.85385	50.0	8.28				71.50	117.20	6.000	130.00	0.050	1.700	0.222	548.00	13.90		5.160					
St. Leon	50.43379	-117.85385	49.0	8.28				70.40	114.80	5.600	127.00	0.100	2.000	0.224	532.00	16.70		4.800					
St. Leon	50.43379	-117.85385	48.3	8.55		-0.181		34.30	131.00	7.100	157.81	0.130	2.260	0.230	535.00	15.86		5.690		0.050			
St. Leon	50.43379	-117.85385	46.5	8.40			957.0	63.80	116.00	5.800	142.00	0.100	5.000	0.236	560.00	59.00							3.80
St. Leon	50.43379	-117.85385	43.3	8.19			809.0	56.50	111.00	5.220	128.00	0.096	2.260	0.230	523.00	16.70		4.310					
St. Leon	50.43379	-117.85385	46.6	8.58			882.0	57.90	116.00	5.390	137.00	0.053	2.280	0.233	548.00	13.70		4.019					
Sulphur Cold	53.045183	-118.082500	8.8	7.00				8.20	66.20	9.800	95.00	32.100	82.200	0.319	168.00	265.00							
Takhini	60.878700	-135.358500	46.2	6.60				89.10	35.10	8.800	611.00	79.200	1.000	0.033	1670.00	112.00							
Talheo North	52.209080	-126.939700	64.0	8.02				107.00	157.50	7.000	15.60	0.050	90.000	0.390	168.00	81.90		6.020					
Tatshenshini	59.500000	-137.666667																					
Taylor	50.053880	-117.934860	25.0	7.98				28.80	31.50	2.800	18.80	1.200	6.100	0.037	60.00	58.90		1.580					
Taylor	50.053880	-117.934860	23.3	8.39			203.0	14.30	32.50	2.579	18.89	1.159	7.389	0.046	65.67	58.50		1.380					
Tchentlo	55.233050	-125.250270	26.8	6.68	1033			17.60	3.25	1.210	137.00	40.000	0.237		4.86	652.00							
Tlell	53.250000	-132.000000	7.5					111.00	870.00	62.000	308.00	0.300											
Toad River	58.924830	-125.077830																					
Toby Creek (Delphine Creek)	50.416667	-116.316667	11.0	6.30				12.20	94.20	4.800	408.00	97.000	9.600	0.101	714.00	1080.00		1.440					
Toby Creek (Delphine Creek)	50.416667	-116.316667	8.9	6.28		263.6	3068.0	70.00	137.00	5.900	509.00	124.000	13.000	0.148	900.00	1307.00							
Trutch	57.733333	-122.966667																					
Tsek (Skookumchuck St Agnes)	49.965000	-122.431389	54.0	8.40				62.00	240.00	5.000	130.00		340.000		420.00	15.80							
Tsek (Skookumchuck St Agnes)	49.965000	-122.431389	54.0	7.63				77.00	243.00	8.300	153.00	0.200	335.000	0.233	398.00	12.30		2.400					
Tsek (Skookumchuck St Agnes)	49.965000	-122.431389	50.0	7.90			938.0	57.60	242.00	7.300	157.00	0.300	18.600	0.202	434.00	18.60						9.700	
Tsek (Skookumchuck St Agnes)	49.965000	-122.431389	46.6	8.17			1470.0	55.40	240.00	7.120	154.00	1.190	360.000	0.209	383.00	13.60		2.180		0.447			
Tuitye (Stinky)	63.800000	-129.870000	24.0																				
Turbid Creek	50.100556	-123.294444	29.1	8.10			5438.0	89.00	911.00	73.000	474.00	168.000	1190.000	1.300	1140.00	1400.00		0.500	0.020	3.900			
Turbid Creek	50.100556	-123.294444	27.2	5.99			4230.0	81.09	772.00	58.200	412.00	131.000	869.000	1.519	1020.00	1260.00		0.180		3.829			
Turbid Creek	50.100556	-123.294444	16.4	5.83			5000.0	51.90	917.00	160.000	299.00	63.600	1800.000	4.039	69.80	848.00		0.175		5.090			
Turbid Creek	50.100556	-123.294444	15.5	6.15			4100.0	66.19	716.00	57.400	406.00	120.000	846.000	1.230	1030.00	884.00		0.152		3.230			
Twenty Mile Bay	49.536435	-121.882589																					
Unnamed	62.030000	-128.280000																					
Unnamed	62.400000	-127.920000																					
Unnamed	64.500000	-125.000000																					

APPENDIX F: Hot Spring Geochemistry

Name	Al	As	Ba	Be	Bi	Cd	Co	Cr	Cu	Fe	Hg	Mn	Mo	Ni	P	Pb	Rb	Sb	Se	Sr	Si	Ti	Zn	Discharge (L/s)	'92 Geothermal Map No.	Reference	Comments
Sloquet		0.0040										0.0020								0.24						Souther 1976	55a
Sloquet		0.0060										0.0050								0.24						Souther 1976	55b
Sloquet									0.006	0.010		0.0090								0.50			0.002			Grasby 2000	
Snippaker Creek (Julian Lake)																										Woodsworth 2013	
Snowshoe Rabbit																									S93		
Sphaler Creek																								0.2	S11		
St. Leon		0.0020										0.0020								2.64				0.63	S69	Souther 1976	31a
St. Leon		0.0040										0.0050								2.40				0.95		Souther 1976	31b
St. Leon	0.020		0.020							0.040										5.72						Philips 1994	
St. Leon									0.003	0.023		0.0110								5.20			0.011			Grasby 2000	
St. Leon																								1.00		Geoscience BC 2016-xx	(HS1 2007 sample) Polaris Infrastructure kind permission
St. Leon																								0.50		Geoscience BC 2016-xx	(HS2 2007 sample) Polaris Infrastructure kind permission
Sulphur Cold																										Grasby 2000	
Takhini																										Grasby 2000	
Talheo North		0.0240										0.0020									0.40				S41	Souther 1976	
Tatshenshini																									S1		
Taylor		0.0010										0.0020								0.01					S73	Souther 1976	Coordinates from Woodsworth 2014
Taylor																								1		Geoscience BC 2016-xx	(2007 sample) Polaris Infrastructure kind permission
Tchentlo		0.0041																						1	S22	Geoscience BC 2016-xx	(2007 sample) Polaris Infrastructure kind permission
Tlell																									S27	Souther 1976	
Toad River																									S9	Woodsworth 2014	Hot
Toby Creek (Delphine Creek)		0.0010										0.7300								0.76					S75	Souther 1976	
Toby Creek (Delphine Creek)									0.012	0.040		0.8890								2.10			0.019			Allen 2006	
Trutch																									S17		
Tsek (Skookumchuck St Agnes)																								0.67	S87	N.S-B.G 1974	
Tsek (Skookumchuck St Agnes)		0.0010										0.0200								1.44				0.95		Souther 1976	
Tsek (Skookumchuck St Agnes)									0.005	0.050		0.2570								2.40			0.003			Grasby 2000	
Tsek (Skookumchuck St Agnes)																								2.50		Geoscience BC 2016-xx	(2007 sample) Polaris Infrastructure kind permission
Tuitye (Stinky)																										NWT 2010	
Turbid Creek	0.080	0.2000		0.001	0.200	0.002	0.010	0.004	0.005	0.190	0.05000	0.9300	0.01	0.01	0.1	0.050		0.100	0.0700				0.104		S61	Dellechaie 1984	
Turbid Creek	0.021																0.186							1		Geoscience BC 2016-xx	(Spring 2007 sample) Polaris Infrastructure kind permission
Turbid Creek	0.004																0.470							0.02		Geoscience BC 2016-xx	(Seep 2007 sample) Polaris Infrastructure kind permission
Turbid Creek																	0.188							0.02		Geoscience BC 2016-xx	(Seep 2007 sample) Polaris Infrastructure kind permission
Twenty Mile Bay																										Woodsworth 2013	
Unnamed																										NWT 2010	
Unnamed																										NWT 2010	
Unnamed																										NWT 2010	

APPENDIX F: Hot Spring Geochemistry

Name	Lat	Long	Temp (C)	pH	Conductivity (uS/cm)	Eh (mV)	TDS	SiO2	Na	K	Ca	Mg	Cl	Li	SO4	HCO3	CO3	F	Br	B	I	NO3	H2S
Upper Halfway	50.498650	-117.654660	55.0	8.31			758.0	67.80	102.00	5.420	97.20	0.097	4.030	0.218	456.00	19.00		4.060					
Upper Hot Springs	51.150556	-115.560833	46.0				1098.0				239.00	40.000			634.00	133.00							
Upper Hot Springs	51.150556	-115.560833	47.3	7.10				31.00								138.00							
Upper Hot Springs	51.150556	-115.560833	41.3	7.70			1200.0	37.00	6.30	4.900	258.00	43.500	6.200	0.040	711.00	132.00						0.050	24.30
Vermillion Lake	51.178600	-115.601900	19.7	7.10				9.00								171.00							
Washwash	51.866667	-126.666667																					
Weewanie	53.696830	-128.789000	48.0	8.60																			
Whiskey Point	50.695000	-117.816667																					
Wild Horse	49.810640	-115.48164	28.5	7.22				22.10	5.00	5.200	301.00	48.400	2.300	0.027	828.00	119.30		0.800					
Wild Horse	49.810640	-115.48164	12.5	7.52				10.60	1.60	2.300	119.00	24.000	1.100	0.017	276.00	135.20		0.336					
Wild Horse	49.810640	-115.48164	31.0	7.13		+537	1629.0	30.70	5.90	6.200	378.00	59.500	2.400	0.023	1038.20	105.30		0.700				0.210	
Wild Horse	49.810640	-115.48164	33.0	7.11	1703		1670.0	27.70	6.59	6.900	383.00	62.700	3.590	0.026	1090.00	108.00		0.712					
Wild Mint	61.420000	-126.580000	29.0					45.00	1.40	2.540	125.00	25.500											
Williams Lake	51.966667	-121.833333	12.0	6.50																			
Wilson	50.218611	-117.551667	33.1	9.22			88.8	40.79	17.39	0.140	7.55	0.046	0.159		17.10	36.59		0.027					
Wolfenden	50.833333	-116.266667	27.7	6.80			1097.0	18.20	48.40	4.600	120.00	84.700	78.000	0.017	210.00	531.00						4.500	

APPENDIX F: Hot Spring Geochemistry

Name	Al	As	Ba	Be	Bi	Cd	Co	Cr	Cu	Fe	Hg	Mn	Mo	Ni	P	Pb	Rb	Sb	Se	Sr	Si	Ti	Zn	Discharge (L/s)	'92 Geothermal Map No.	Reference	Comments
Upper Halfway																								0.3			
Upper Hot Springs																								8.2		Souther 1973	
Upper Hot Springs																										Mazor 1973	
Upper Hot Springs									0.004	0.035		0.0060								1.70			0.016			Grasby 2000	
Vermillion Lake																										Mazor 1983	
Washwash																									S47		
Weewanie																									S29		
Whiskey Point																									S66		
Wild Horse		0.0040										0.0020								1.08				6.3	S100	Souther 1976	23a. Coordinates from Woodsworth 2014
Wild Horse		0.0040										0.0050								0.36				12.6		Souther 1976	23b
Wild Horse									0.012	0.032		0.0130								2.60			0.009			Allen 2006	
Wild Horse																								3.0		Geoscience BC 2016-xx	(2008 sample) Polaris Infrastructure kind permission
Wild Mint																								50		NWT 2010	
Williams Lake																									S55		
Wilson																								3.5	S72	Geoscience BC 2016-xx	(2007 sample) Polaris Infrastructure kind permission
Wolfenden										0.111		0.8500								1.80						Grasby 2000	

APPENDIX G:
Project Team Members

APPENDIX G: PROJECT TEAM MEMBERS

The team who carried out the research has an impressive level of experience in the community engagement and Direct-use geothermal field. With their knowledge of green-field geothermal exploration, depth of experience, intimate knowledge of the geology of British Columbia, and highly advanced skills in community engagement, they were able to execute the project efficiently. Each member brought a specific expertise to this highly qualified team of geothermal practitioners. Below are brief summaries of each of the members and the role they played in the project.

Dr. Catherine Hickson P.Geo. – Project Manager and Science co-leader

Dr. Catherine Hickson provided overall project management and team leadership. Dr. Hickson is the President of Tuya Terra Geo Corp. and has more than 35 years' experience in geology, geothermal energy and managing high performance, multidisciplinary teams. For twenty-five years she worked for the Geological Survey of Canada (GSC) in various capacities including executive roles. She began her career with the GSC working on the Mount Meager geothermal project and other heat flow projects. In 1992, she was the scientific authority for the Geothermal Map of British Columbia (Fairbank and Faulkner 1992). In 2008, she joined a private sector energy company, Alterra Power Corp. which focused on geothermal energy exploration and development. She built a global portfolio of green-field concessions for the company, several of which are now partnered to other companies for advanced exploration, including the global geothermal giant, Energy Development Corp. (Philippines). In 2013, she left the company when they ceased green-field exploration. In the last two years she has built a strong client base of Canadian and international companies and continues to work in geothermal energy. She has published numerous scientific papers including a recent publication on "The Geothermal Exploration and Development Process: Graphical Representation Path to Optimal Decision Making" presented at the Geothermal Resources Council meeting, October 2014, in Portland Oregon.

Mr. Gerald W. Huttrer – Direct-use expert and Science co-leader

Mr. Gerald W. Huttrer is President of Geothermal Management Company, Inc. (GMC). GMC is a consultancy, founded in 1985, specializing in provision of services to the geothermal industry. These are focused on the geoscientific aspects of low, medium, and high temperature projects that have been conducted in 47 geothermally prospective countries.

Mr. Huttrer collaborated with Dr. Lund, and Ms. Boyd on several Direct-use projects in the past and brought them to the team to complete the *Roadmap* for the project. Generally, Mr. Huttrer studies the geologic and sub-surface situations. Over his more than 40 years in the geothermal industry, Mr. Huttrer has gained a wide range of Direct-use experience including, but not limited to: space heating and cooling, greenhouse and aquaculture pond heating, industrial applications, geothermal (ground-source) heat pumps, snow-melting, and combined heat and power facilities.

Mr. Huttrer is a geothermal geologist with a B.A. from Dartmouth College and an MS from the University of Washington. He has worked in the geothermal industry since 1969 and has conducted geothermal studies for heat-pump-related, Direct-use, and electric power generation internationally for entities including the U.S. and foreign governmental agencies, private and corporate entrepreneurs, investment banks, petroleum and mining companies, tribal organizations, and Multi-Lateral Development Banks. He is a past president and multi-term director of the Geothermal Resource Council (GRC), a founding member of the International Geothermal Association and is a recipient of the prestigious Aidlin Award from the GRC.

Mr. Huttrer's Direct-use projects include evaluation of the potential for economic development of low to medium temperature resources in: the entire state of Alaska (for the National Renewable Energy Laboratory), the city of Steamboat Springs, Colorado, the City of Glenwood Springs, Colorado, the City of Ouray, Colorado, the City of Pagosa Springs, Colorado, Fallon Naval Base, Nevada, the City of Banya Luka, Bosnia-Hertzegovina, and the whole of the Western United States (for Geoterma, Paris-Nord, France).

Dr. Titi Kunkel – Science co-leader

Dr. Titi Kunkel has over 25 years of international training and education project experience. Her work in the last ten years has primarily been in the Cariboo and Chilcotin regions of BC, working with Aboriginal communities. She received her Ph.D. from University of Northern BC in 2015 and continues to work with the university developing and delivering programs for rural and remote communities. Dr. Kunkel's dissertation assessed the compatibility of geothermal resource development and Aboriginal values within the Nazko and Xeni Gwet'in First Nations communities. Her work sheds new light on Aboriginal values in the region and the significance of these in economic development. She sits on the Board of Directors for Community Futures Development Corporation for the North Cariboo and the Nazko Economic Development Corporation. She has led numerous community-based research projects for Aboriginal communities in the region. Of note is her work with the Tsilhqot'in Nation communities to identify Aboriginal values in an area of cultural interests and significance to the people. She presented her findings at the two Federal Environmental Assessment panels (2010 and 2013) and at the World Mining Congress of 2013 in Montreal.

APEX Geoscience Ltd. – Geology and geomatics

Tuya Terra Geo Corp subcontracted APEX Geoscience Ltd. as an integral part of the team to provide geomatics support for the project. APEX has been providing geological consulting services to small and large exploration companies around the world for more than 20 years. APEX brings to the project their experience in British Columbia exploration through their highly experienced team of geoscientists and sophisticated software and database management expertise. They also have considerable experience in technical reporting, geological modelling and resource estimation services.

Through APEX, Ms. Yuliana Proenza, P.Geo and Mr. Bahram Bahrami, P.Geo were engaged.

Ms. Proenza is a geologist with APEX Geoscience Ltd. She has a BSc in Earth & Planetary Sciences from McGill University (2007) followed by a Master of Engineering in Clean Energy Engineering from University of British Columbia in 2012. Her thesis built a conceptual model for the Mount Meager geothermal system (Proenza 2012). She has been working for the mineral exploration industry since 2006 and is proficient in Geographical Information Systems (ArcGIS and MapInfo), 3D modelling and exploration targeting (Micromine, Leapfrog 3D, Maptek Vulcan, Gemcom Surpac) and data management solutions (Microsoft Access). She helped in final report writing, review and analysis of the GDDM data.

Mr. Bahrami is a geologist and geomatics specialist with APEX Geoscience Ltd. He has a BSc In Earth Sciences from Simon Fraser University (2008), followed by an Advanced Diploma in Geographic Information Systems (GIS) from British Columbia Institute of Technology in 2009. He has over six years' experience in the mineral exploration industry, and is an expert in GIS (ArcGIS, Quantum GIS, MapInfo) and 3D modelling software (Micromine, Geosoft). Mr. Bahrami compiled the GIS information for the project.

Ms. Toni Boyd – Geomatics specialist and direct use expert

Ms. Toni Boyd holds BS degrees in Civil Engineering Technology and Civil Engineering from the Oregon Institute of Technology (OIT). She has been involved in all aspects of geothermal Direct-use projects for more than 21 years and rose from her initial Lab Testing Technician position at OIT to Senior Engineer and Acting Director. Ms. Boyd has extensive computer experience and has edited and been responsible for graphics on numerous OIT and international publications. She is also an expert in creation of geothermal databases for both resources and surface applications. She is a multi-term director of the Geothermal Resources Council (GRC) and was the Direct-use Chair of the GRC Annual Meetings from 2001-2015 as well as for the World Geothermal Congresses in 2005, 2010, and 2015. Ms. Boyd has also authored and co-authored a great many articles and publications regarding geothermal Direct-use.

Ms. Leah Hjorth - Research Associate

Ms. Leah Hjorth has a BA in Education from the University of British Columbia and she is a member of the Nazko First Nation. Ms. Hjorth completed most of the community contacts, focusing on First Nations. She had previous experience working with Aboriginal communities in the Cariboo region. Ms. Hjorth also worked with Dr. Kunkel on community-based research projects using questionnaire surveys and semi-structured interviews. In addition, she worked with Drs. Kunkel and Hickson on a project to investigate geothermal resource potentials in the Nazko area.

Dr. John Lund PE – Direct-use expert

Dr. John Lund is one of the world's leading geothermal Direct-use experts with more than 45 years' experience in the geothermal industry. He holds BS and PhD Civil Engineering degrees from the University of Colorado and an MS Civil Engineering degree from the University of California, Berkeley. Dr. Lund was associated with the Oregon Institute of Technology Geo-Heat Center from 1980 through 2010 and held Professorial, Dean, and Director Positions throughout these 30 years. He has lectured to governmental, academic, industrial, and private audiences all over the world and has innumerable geothermal publications regarding all surface-related aspects of Direct-use. Dr. Lund is a past president of the Geothermal Resources Council and of the International Geothermal Association.

Dr. Lund's most recent presentations include: a four-lecture series on Direct-use applications to the 2014 ASHRAE Conference in Salt Lake City, Utah, six lectures on Direct-use applications to the Canadian Geothermal Energy Association (CanGEA) in Calgary in March 2014, and a Keynote speech/overview of geothermal Direct-uses to the Asian Pacific Energy Conference in Taipei, Republic of China in June 2013. Dr. Lund also has done extensive field work in Klamath Falls and Lakeview, Oregon as well as in Steamboat Springs, Glenwood Springs, and Pagosa Springs, Colorado.

Dr. Jacek Majorowicz – Heat flow

Dr. Jacek Majorowicz is a global expert in heat flow. He brought a deep understanding of the subsurface thermal regime as determined through boreholes and other data (Majorowicz and Grasby, 2010a & b) to the team. He has studied thermal problems on a variety of scales applied to geothermal systems including the state of the lithosphere, geothermal energy of the sedimentary basins, engineered geothermal systems (EGS), and thermal maturation-basin studies. Previous works have included heat flow and magnetotelluric work done for the Cordillera and sedimentary basins in BC which included the BC part of Western Canadian Sedimentary Basin, and Bowser and Nechako basins in the Intermontane Belt. The majority of these studies and resulting study reports have been published as scientific papers in top geophysical and geological journals in America and Europe. Of note is his work on enhanced geothermal systems in Canada and the identification of high potential regions.

Dr. Michal Moore – Energy Economist

Dr. Moore is one of the leading thinkers on energy economics in North America. Major research areas and interests include the operation and oversight of energy markets, including the interaction of oil and gas and electric systems. Recent research has focused on the integration of geothermal and solar energy facilities with the national grid in Australia and in Canada. He holds academic appointments in energy economics and systems engineering at both Cornell University and the University of Calgary. He is the current Area Director of Research for Energy and Environment at the School of Public Policy in Calgary and works with researcher faculty at Carleton University on a broad range of public education and literacy projects oriented to improving public perception and understanding of energy systems. He recently co-authored a major report on geothermal resource potential in Australia, and was a co-author of the first report to comprehensively identify geothermal resources throughout Canada. Dr. Moore is currently teaching classes in renewable energy technologies, and developing low temperature geothermal systems to assist in neutralizing pathogens in human waste for developing nations.

Dr. Glenn Woodsworth P.Geo – Structure, hot springs of British Columbia

Dr. Glenn Woodsworth has over 45 years' geological experience in British Columbia and brought a thorough understanding of the geology of British Columbia. After receiving his Ph.D. from Princeton University, he joined the Geological Survey of Canada (GSC) as a Research Scientist. His work focused on bedrock geological mapping and structural and metamorphic studies at various scales, and on regional geological syntheses of Cordilleran geology. He has a long interest in hot springs and was a contributor and editor of the Fairbank and Faulkner (1992) Geothermal Map of British Columbia. Since leaving the GSC, he has consulted on various geothermal and regional geology projects within BC. He was the first scientist to call attention to the geothermal potential of the Knight Inlet/Hoodoo Creek area. Dr. Woodsworth has published over 120 papers, reports, and maps on the many aspects of Cordilleran geology, and his *Hot Springs of Western Canada* (3rd edition, 2014) is the standard work on the topic.

Mr. Ron Yehia – Geochemistry and geomatics

Mr. Ron Yehia is an experienced geothermal and grassroots exploration geologist. Mr. Yehia was the Canada Exploration Lead at Vancouver-based Alterra Power, where he was responsible for planning and managing exploration in Western Canada as well as managing the geoscience hardware and software. At Alterra, he also participated in overseas exploration including assessment of various exploration tools and techniques. Prior to Alterra, Mr. Yehia was an exploration geologist at Ormat Technologies based in Reno, Nevada, where additional duties included responsibility for British Columbia exploration and as Manager of the Resource Group geodata. Currently, Mr. Yehia is consulting as an exploration geologist offering expertise and services in real-time hydrogeology results acquisition, and geoscientific solutions specializing in open source tools. He compiled a GIS database of geochemistry results for British Columbia incorporated into this report and available online at:
http://www.arcgis.com/home/item.html?id=cebc4e70ad4c48fd8314a681ae65f09c