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December 12, 2018
Project No.: P18374

Mike Simpson, Senior Regional Manager
Fraser Basin Council
200A – 1383 McGill Road
Kamloops, BC V2C 6K7

Dear Mr. Simpson,

Re: Proposed Screening Level Hydraulic Modelling, Thompson River Watershed - DRAFT

1.0 INTRODUCTION

Fraser Basin Council (FBC) requested BGC Engineering Inc. (BGC) provide a preliminary scope of work and cost estimate to support their coordination of funding applications by Regional District Governments to the Union of British Columbia Municipalities (UBCM) Community Emergency Preparedness Fund (CEPF) to undertake screening level flood modelling in the Thompson River Watershed (TRW).

The UBCM CEPF can be applied to for flood risk assessment, flood mapping, and flood mitigation planning projects in BC[1] and applications are due by February 22, 2019. Possible applicants include the Thompson Nicola Regional District, Columbia Shuswap Regional District (CSRD), Regional District of North Okanagan (RDNO), and Cariboo Regional District (CRD). If a decision to go ahead with a funding application is made, BGC will provide a more detailed work plan and cost estimate, which will supersede this letter.

BGC proposes to apply to the UBCM CEPF for a total of $250,000 to complete large scale screening level flood mapping across the TNRD, CSRD, RDNO, and CRD. Unless funding constraints dictate otherwise, BGC suggests that the funding application amount be split according to the proportion of mapping proposed in each District.

2.0 BACKGROUND

A geohazard risk prioritization initiative for the entire TRW (Figure 3-1) was launched in February 2018 at a Community-to-Community Forum in Kamloops, BC coordinated by FBC with participation of local governments and First Nations.

[1] Details on the CEPF can be found at https://www.ubcm.ca/EN/main/funding/lgps/community-emergency-preparedness-fund/flood-risk-assessment-mapping-mitigation-planning.html

FBC retained BGC to carry out a regional flood risk prioritization study for the TRW with the support of Kerr Wood Leidal Associates (KWL), with funding provided by Emergency Management BC (EMBC) and Public Safety Canada under Stream 1 of the Natural Disaster Mitigation Program (NDMP, 2018, the Regional Study). This work is being carried out under the terms of an agreement between FBC and BGC dated April 2, 2018 and is due for completion by March 31, 2019.

Building on the Regional Study, an August 31, 2018 application was submitted jointly by FBC and BGC to EMBC for two proposals to the federal NDMP (equal cost sharing by BC and Canada) including:

- Stream 4b application to acquire LiDAR data ($1.4 M application)
- Stream 2 application to develop flood maps ($5.5M application).

The Stream 4b application was supported by EMBC and forwarded to Public Safety Canada for their consideration, but the Stream 2 application was not supported due to funding schedule constraints in relation to the large scope of work. Given that this was the final year of the NDMP, it is unknown when a future large funding program to support flood mapping will be announced. As such, FBC and BGC are seeking alternative funding through the UBCM CEPF. Inquiries from FBC and BGC to EMBC and UBCM in a November 21, 2018 phone call and email exchange have determined that there is $2M of funding available, and the desire is to disperse funds over the entire province. Individual applications are capped at $150k according to UBCM. Therefore, completing all or even a portion of the flood mapping as proposed in the NDMP Stream 2 application is not feasible. The scope of work and budget described in this preliminary work plan has been adjusted from the August 31, 2018 scope and cost estimate put together by BGC for Stream 2 funding to reflect the available funding through the UBCM program.

3.0 SCOPE

BGC would like approval from applicant Districts to partner with BGC at the application stage, and to complete the work if the application is successful. Separate UBCM CEPF funding applications would be prepared by staff in each District. BGC proposes to prepare a single work plan and cost estimate document to append to all applications, because the study methodology and watershed scale study approach would be consistent across all areas assessed.

3.1. Objective

The current Regional Study is prioritizing clear-water flood hazards with the potential to impact communities and infrastructure within the TRW. A flood map is used to identify the boundaries of a potential flood event based on type and likelihood (e.g., 200-year return period), and can be used to identify potential impacts of a flood event to protect human life and minimize property damage. In addition, flood hazard maps can support activities such as:

- Emergency planning and operations
- Bylaw compliance and revisions

- Flood mitigation planning.

Historical floodplain mapping completed under the Canada/British Columbia Agreement Respecting Floodplain Mapping program (1974-2003) was largely standard-based and focused on inundation mapping for the 200-year return period flood. Mapping completed in the program often lacked a design report to document the methods and assumptions used to create the maps.

As described in Section 3.1, of the 18 clear-water flood hazards identified, 11 areas have existing flood mapping developed under the previous program, while 7 areas are without existing historical floodplain mapping or flood protection measures. Areas with historical floodplain mapping within the TRW are on average 30 years old and do not:

- Reflect the full data record available for hydrometric stations within the watershed
- Reflect potential changes in channel planform and bathymetry (e.g., aggradation, channel alterations such as bank erosion or avulsion)
- Consider land use changes (e.g., wild fire)
- Consider climate change impacts on flooding.

While flood mapping studies are an important tool for developing safe and resilient communities, detailed studies are expensive and time consuming and therefore undertaken only when there are recognized hazards – which forms a “chicken and egg” scenario.

Recognizing the cost of detailed flood mapping, organizations responsible for flood management in the USA have begun to consider less costly flood mapping at a screening level of detail. The US Federal Emergency Management Agency (FEMA) refers to this level of assessment as Base Level Engineering (BLE). The BLE approach brings together high resolution topographic data if available, regional hydrology evaluations, and highly automated hydraulic modeling, to provide screening-level flood mapping and hydraulic models that can be refined at a later date if more detailed mapping is desired. The flood maps produced using BLE, while not as accurate as maps produced by detailed flood mapping studies, can nonetheless be used to provide a preliminary understanding of where flood hazards may exist which allows for:

- Identification of sites that may be subject to flood hazards
- Prioritization of sites for detailed study
- Conversations to occur at the community and regional level that center around flood risk including mitigation strategies to reduce existing or future flood risk.

The methodologies that would be developed by BGC for screening level flood modelling in the TRW would be based on a level of detail that reflects the resolution of input data, as well guidance provided by FEMA on BLE benchmarks.

While workarounds have been developed by BGC, the proposed modelling would help fill a key gap in the current Regional Study, namely the lack of the most basic floodplain mapping in many areas. The results of screening level modelling would be added to the web application (currently under development by BGC) that will display the results of the Regional Study.

BGC also notes that the screening level modelling is not fundamentally different than detailed modelling – it is the level of detail that is lower. The lesser detail is the reason for the much lower cost. A spectrum of possible effort and cost depending on the desired detail can be added. This means that efforts for screening level modelling are not wasted when opportunities arise to increase the level of detail.

3.2. Study Area

BGC proposes to complete screening level flood mapping for the areas proposed in the August 31, 2018 NDMP Stream 2 funding application, as shown in Figure 3-1. From discussions with EMBC staff, this is the most likely proposal to be supported, and given the lack of known funding sources to complete flood mapping, it will provide better information than currently exists for emergency response and planning.

Table 3-1 summarizes the proposed flood mapping areas within the TRW by District as part of the original Stream 2 funding application, with further details on the 18 locations proposed for mapping provided in Table 3-2. The 18 proposed flood mapping locations includes 11 areas with and 7 areas without existing historical floodplain mapping or flood protection measures. Flood mapping is proposed upstream and downstream of each identified clear-water flood site shown on Figure 3-1 for an area and length approximated in Table 3-2. Candidate sites were developed based on information compiled to date, records of historical events, and professional judgement.

Section 6.0 provides a preliminary cost estimate breakdown according to the proportion of mapping in a given District. Possible application amounts per District have not yet been confirmed. Once confirmed, BGC will re-issue this Draft work plan with a revised list of candidate areas if required to fit the potentially available funding.

Table 3-1. Summary of clear-water flood hazard areas identified for potential flood hazard mapping.

Regional District	Number of Proposed Mapping Locations	Total Mapping Area	Proportion of Total Mapping Area
CRD	1	72	10%
CSRD	3	94	13%
RDNO	3	118	16%
TNRD	11	442	61%
Total	**18**	**726**	**100%**

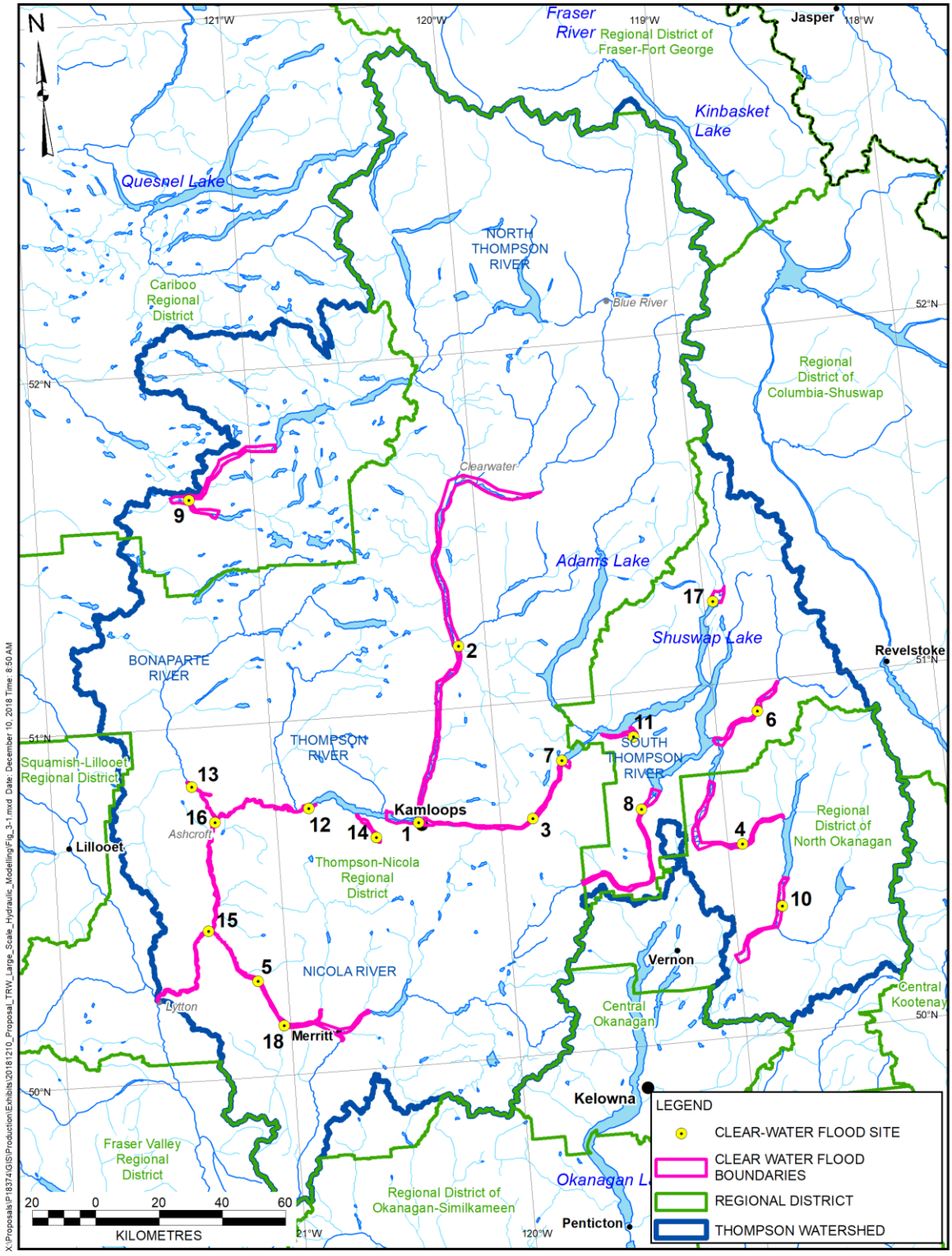

Figure 3-1. Selected site areas for flood mapping, shown in pink.

Table 3-2. Summary of clear-water flood hazard areas identified for potential flood hazard mapping.

Site No.	Watercourse (Area)[1]	District	Approximate Floodplain Area (km^2)	Approximate Floodplain Length (km)	Census[3] Block Total Population	Census[3] Block Total Building Count	Floodplain Mapping? (Map Year)[4]	Flood Protection Measures?[5]	2018 Identified Priority?[6]	Recorded Historical Flood Events[7]	Comments
1	Thompson River (Kamloops Area)	TNRD	35.2	12	17,327	4,978	Yes (1976, 2004 update)	Yes	Yes	1894, 1928, 1948, 1972, 1990, 1997, 1999, 2012	City of Kamloops updated floodplain maps in 2004. Portion of Tk'emlups te Secwepemc reserve land had floodplain mapped in 2004. The 2004 mapping was accepted by the Province as the official floodplains (BC Real Estate Association, October 2015).
2	North Thompson (Vavenby to Kamloops)	TNRD	210.8	120	9,290	3,502	Yes (1982)	Yes	Yes	1894, 1928, 1948, 1972, 1990, 1997, 1999, 2012	TNRD is currently undertaking an official community plan in North Thompson. River is prone to ice jams. Areas with existing floodplain mapping could be considered (e.g., Lower Barriere River has existing floodplain mapping but could be extended to the upper reaches of Barriere River). Additional areas that could be considered for floodplain mapping include Clearwater, Little Fort and 100 Mile House.
3	South Thompson River (Kamloops to Chase)	TNRD	39.6	50	6,445	2,594	Yes (1976, 2004 update)	Yes	Yes	1894, 1928, 1948, 1972, 1990, 1997, 1999, 2012	City of Kamloops updated floodplain maps in 2004. Portion of Tk'emlups te Secwepemc reserve land had floodplain mapped as part of City of Kamloops in 2004. Area could be prioritized lower due to more recent floodplain mapping.
4	Shuswap River (Mara Lake to Mabel Lake)	RDNO	62.9	50	3,352	1,504	Yes (1980)	Yes	Yes	1983, 1990, 1997, 1999, 2012, 2018	Flooding at the northern extent of Shuswap River is influenced by Mara Lake levels. In 1990 and 1997 some of the flood events were debris flows and debris floods in tributaries adjacent to floodplain triggered by intense rainfall. Frequent flooding of Highway 97A near Grindrod. City of Enderby completed floodplain mapping for the Shuswap River in 2012 (FBC, February 14, 2018).
5	Nicola/Coldwater Rivers (Nicola Lake to Spences Bridge)	TNRD	53.0	78	3,230	1,284	Yes (1989)	Yes	Yes	1894, 1922, 1954, 1974, 1980, 1984, 1991, 1997, 2002, 2017, 2018	Debris and sediment pile up at mouth of Nicola River at Spences Bridge. LiDAR was collected in 2016 for City of Merritt. Stump Lake previously flooded in 2017 and TNRD is assessing options to manage Stump Lake water levels. Many of the areas in Nicola/Merritt Valley were impacted by 2017 and 2018 flooding resulting in temporary installation of emergency protection structures (e.g., Guichon Creek). First Nations completed 2015 hydrological study and has funds for mitigation planning.
6	Eagle River (Malakwa to Sicamous)	CSRD	34.0	35	2,487	1,048	Yes (1979)	Yes	No	1967, 1972, 1982, 2012	Flooding at the western extent of Eagle River is influenced by lake levels on Shuswap and Mara Lakes. Costs for flooding damage in Sicamous area (including steep creeks on Sicamous and Hummingbird Creeks) totaled approximately $3.8M (Public Safety Canada, n.d.). Sicamous completed a hydrological connectivity study and applied for flood mitigation funding for Sicamous Creek.
7	Chase Creek (Chase)	TNRD	3.5	5	2,297	1,148	No	No	Yes	1935, 1948, 1960, 1972, 1996	Past flood events from high water levels, Little Shuswap Lake.
8	Salmon River (Falkland to Salmon Arm)	CSRD	47.6	50	2,267	994	Yes (1991/1992, 2011 update)	No	Yes	1894, 1972, 1999, 2018	Flooding at the northern extent of Salmon River is influenced by lake levels on Shuswap Lake. Adams Lake Indian Band is currently conducting climate modelling for Chase Creek, Salmon River, and others. Lower reaches around Salmon Arm have updated floodplain mapping (2011).

Site No.	Watercourse (Area)[1]	District	Approximate Floodplain Area (km²)	Approximate Floodplain Length (km)	Census[3] Block Total Population	Census[3] Block Total Building Count	Floodplain Mapping? (Map Year)[4]	Flood Protection Measures?[5]	2018 Identified Priority?[6]	Recorded Historical Flood Events[7]	Comments
9	Bridge Creek (Camin Lake to 100 Mile House)	CRD	72.0	30	2,109	1,132	No	No	Yes	1997,1999	Flooding in 1999 caused approximately $400,000 in damage including bridge replacement. An ice jam on Bridge Creek near 100 Mile House created localized flooding in 1997. Wildfire near 100 Mile House in 2017 (Gustafsen Fire), mitigation planning underway.
10	Shuswap River, Bessette & Duteau Creeks	RDNO	43.4	20	1,548	674	Yes (1998)	Yes	No	1983, 1997, 1999, 2012, 2018	Flooding at the northern extent of Shuswap River is influenced by Mabel Lake levels and the Shuswap Falls dam. Regional District of North Okanagan applied for structural mitigation upgrade funding. Village of Lumby secured funding for floodplain mapping in 2017. In May 2017, approximately 7.7 km of creek banks and earthworks were installed for emergency flood response.
11	Shuswap Lake (Southern Shuswap, Blind Bay, Sorrento)	RDNO	11.5	10	1,460	690	No	No	No	1935, 1948, 1960, 1972, 1996	Several past flood events from rise of Shuswap Lake
12	Thompson River / Kamloops Lake (Savona to Ashcroft)	TNRD	14.8	30	1,255	555	No	No	Yes	1894, 1948, 1972, 1990	Past flood events from rise of Kamloops Lake and flooding on Deadman Creek. Flooding has caused damage to property within Savona and infrastructure (bridges and railway lines) along Thompson River. Flooding in 1990 caused approximately $50,000 in damage (Septer, 2007).
13	Bonaparte River (Cache Creek)	TNRD	35.0	35	616	281	Yes (1996)	Yes	Yes	1866, 1875, 1880, 1990, 1997, 1999, 2015, 2017, 2018	Flooding in 1990 caused approximately $100,000 in damage (Septer, 2007). 40% of Bonaparte River catchment was burned in 2017 Elephant Hill wildfire (SNT 2017). Existing floodplain mapping limited to Cache Creek and could be extended to Ashcroft. Cache Creek has secured funding for flood mapping studies (FBC, February 14, 2018).
14	Cherry Creek	TNRD	8.8	10	186	63	No	No	Yes	1997, 2018	Impacts to homes and roads during previous flood events.
15	Thompson River (Spences Bridge to Lytton)	TNRD	17.5	30	173	65	No	No	Yes	1894, 1900, 1958, 1972, 1974, 1990, 1999	History of past flood and landslide events along the Thompson River corridor between Spences Bridge to Lytton. In 1899 a landslide event dammed the Thompson River at Spences Bridge.
16	Thompson River (Ashcroft to Spences Bridge)	TNRD	22.9	30	161	60	No	No	Yes	1881, 1894, 1900, 1903, 1960, 1982	History of past flood and landslide events along the Thompson River corridor between Ashcroft to Spences Bridge. Potential for landslide dam induced flooding.
17	Seymour River at Seymour Arm[2]	CSRD	12.7	8	67	34	Yes (1989)	No	No	Unknown – no historical accounts	Provincial floodplain designation has been withdrawn and mapping information is not accessible on iMapBC (Government of BC, 2016). No additional information was available on the reason why the map was withdrawn.
18	Spius Creek	TNRD	0.8	2	35	15	Yes (1989)	No	No	1997	Developed as part of Nicola/Coldwater Rivers floodplain maps, but identified as unique floodplain in digital floodplain dataset. Fire-related disturbance/aggradation event prior to 1960. Flood event in 1997.

Notes:
1. Refer to Figure 3-1 for floodplain location.
2. Floodplain map indicated as withdrawn from Government of BC website [accessed July 11, 2018]. BGC contacted the Ministry of Environment for the reason the map was removed but did not receive a response at the time of writing.
3. Flood hazard areas were intersected with the draft NRCan exposure model for BC received on March 15, 2018 to estimate the total affected population and number of buildings.
4. Historical floodplain extents were obtained from iMapBC (Government of BC, 2016) were available.
5. The provincial database for flood protection works includes structural works (MFLRNO, 2017a) and appurtenant structures (MFLRNO, 2017b).
6. BGC also considered the priority sites identified in the Community to Community Forum between FBC and the TRW stakeholders (FBC February 14, 2018).
7. Historical flood events based on Septer (2007), DriveBC (MoTI, n.d.), and 2018 freshet-related floods and landslides sources (e.g., media reports).

3.3. Tasks

3.3.1. Approach Overview

Proposed methods will be provided in further detail in a full work plan and cost estimate, to be prepared following Board approval to proceed with the application. In summary, the modelling approach would consider the standards and guidelines defined by FEMA for BLE and would also consider the EGBC Guidelines for Floodplain Mapping and Flood Assessments in BC. The BLE guidelines describe screening-level flood mapping and hydraulic modelling that can be refined at a later date if more detailed mapping is desired. The study would be entirely desktop based with no fieldwork.

3.3.2. Work Plan

Table 3-3 lists tasks to be undertaken for each general areas (watercourse) listed in Table 3-2. BGC notes that tasks will differ in detail for each project area.

Table 3-3. Clear-water flood mapping work plan.

Activities	Tasks	Deliverables/Products	Resources
Project Management	Meetings, project management and administration	Presentations and updates	• BGC team • FBC team • Project stakeholders
Data Compilation and Review	1. Base Data Collection	Base inputs for hazard analyses and study integration such as historical air photographs, regional geology maps and land use coverage maps	• LiDAR (as available) • BGC team • FBC team • Project stakeholders
	2. Asset Inventory Update	Base inputs for model setup and study integration.	• BGC team • FBC team • Project stakeholders
Analysis	3. Hydrology Assessment	Hydrologic inputs for hydraulic modelling	• BGC team
	4. Hydraulic Modelling	Model outputs showing flood extent, flow depth and velocity.	• BGC team
	5. Study Integration	Integration of new hazard mapping results with the Regional Study.	• BGC team • FBC team • Project stakeholders
Final Deliverables	6. Hazard Map Production (via Web Map)	Clear-water flood hazard maps showing the areas of inundation at different return periods	• BGC team
	7. Reporting and Data Services	Description of methods, results, and limitations, and data and web services for dissemination of study results	• FBC team • Project stakeholders

3.3.2.1. Base Data Compilation

A portion of the TRW (3,980 km^2) has been flown with LiDAR or has high resolution digital elevation model (DEM) coverage potentially available from various private and public sources. A total area of 564 km^2 overlaps with the proposed study areas. LiDAR is used in flood mapping to provide topographic information that is not evident on topographic maps generated from photogrammetry, with greater precision.

Additional items to be collated from available sources beyond the information collected in the current Regional Study include:

- LiDAR DEMs where available
- Historical airphotos
- High resolution ortho imagery
- Gauge rating curves and historical cross-section surveys
- Lake levels
- Historical highwater marks
- Accounts of historical floods.

LiDAR surveys are unable to penetrate water surfaces, and detailed hydraulic modelling typically requires bathymetric surveys to account for channel capacity below the previously surveyed water elevation. As a result, modelled inundation areas are conservative. The proposed screening level modelling scope of work does not include bathymetric surveys or consideration of additional details such as: thalweg delineation, top of bank, bridge details, culvert details, geometry details for all flood control structures, cross sections of structures such as dikes and berms, elevations of buildings located in the floodplain, as well as geo-referenced photos of surveyed features.

3.3.2.2. Hydrology Assessment

Relevant historical flow data from the systematic record will be gathered for each site. Additional values will be incorporated based on historical accounts, where available. A flood frequency analysis (FFA) will be completed to develop return period design discharge values.

3.3.2.3. Hydraulic Modelling

BGC will develop a two-dimensional (2-D) hydraulic model from the DEM and FFA generated for each site to develop inundation extents, flood depths and peak flow velocities for clear-water floods. BGC anticipates using the TELEMAC-2D software package, a public domain hydraulic modelling program, as it provides a number of unique characteristics necessary for this project:

- **Open source** – no license fees/restrictions means the software can be installed on an unlimited number of computers, eliminating licensing bottlenecks. Users are also able to modify the code if needed to suit their specific requirements.
- **Parallelized** – the model is fully parallelized, which means it can be run on multi-core machines and/or clustered machines significantly reducing runtimes.

- **Robust** – the solvers are robust for both steady and unsteady flow problems and include shock-capturing capabilities (e.g., for steep creeks, where a sharp, discontinuous change in flow variables occurs).
- **Command Line Interface (CLI)** – TELEMAC-2D uses a CLI which allows for easy scripting and automation of the model and allows it to be used on remote connections

Flexible mesh – TELEMAC-2D uses a flexible mesh allowing the mesh to be designed to conform to the geometric shape of the river and features on the floodplain. It also allows the node density to be adjusted based on the anticipated flow gradients (e.g., high in the channel and lower in the floodplains).

The chosen modelling software will be confirmed in discussion with FBC and stakeholders following confirmation of funding.

Site-specific historical flood discharge and elevation, where available, will be used to validate the model. A sensitivity analysis will be conducted for key parameters. Dike breach modelling is not included in the scope of work.

3.3.2.4. Study Integration

New hazard mapping will be integrated into the Regional Study undertaken as part of NDMP Stream 1 assessment and will be used to update the hazard ratings previously developed by the Regional Study.

4.0 DELIVERABLES

The deliverables of this project will be provided in digital format and will include reports and drawings; a read-only, password-protected web application; and data delivered as a separate download or service from BGC's servers or the cloud[2]. This section provides further details on the format of deliverables provided with the proposed work.

4.1. Reporting

Reporting describing methods and results will be provided in pdf format.

4.2. Hazard Maps

BGC will provide flood hazard mapping results in digital format, displayed on a web application. Newly created flood hazard mapping from the proposed work will be added to the existing information compiled as part of the current Regional Study.

BGC will also provide the flood hazard mapping results via data download, and via an ArcGIS REST API that will allow users to retrieve and interact with the geospatial data in their own applications through ArcGIS Online. Work required for third-party integration with API is not included in the scope of work.

[2] i.e. via software and services that run on the Internet, instead of local servers.

Hazard maps provided as web or data service from BGC will be provided for one year following delivery of the final report and thereafter hosted as a “static” product (e.g., no updates or changes) for a maintenance fee, if requested by FBC.

5.0 TEAM MEMBERS

This section provides representative bios for senior team members – more detailed resumes are available on request. The team is based in BGC’s Vancouver office, except for Patrick Grover (Toronto). Multiple team leads may be proposed given the number of project areas, and the team makeup will also include geomatics professionals responsible for geospatial data processing, management and delivery.

Kris Holm, M.Sc., P.Geo.
Principal Geoscientist and Project Director
Mr. Holm has 20 years of geoscience consulting experience and leads BGC’s geohazards group. His experience includes geohazard and risk assessments for transportation, development and industry at scales ranging from site-specific studies to broad regions. Mr. Holm is leading the current Regional Study for the TRW and has previously led regional flood and geohazard risk prioritization studies for the Province of Alberta, Regional District of East Kootenay, District of North Vancouver, City of Chilliwack, and major industry clients in North and South America. He is also co-author of the Alberta Draft Provincial Guidelines for Steep Creek Risk Assessment, and has completed over 50 detailed, quantitative geohazard risk assessments. Mr. Holm will act as overall project director as well as team lead for the integration of study results into the Regional Study.

Elisa Scordo, M.Sc., P.Ag., P.Geo.
Team Lead, Flood Hazard Mapping
Ms. Scordo is a senior hydrologist with 13 years of diverse experience in water resources, geohazard risk assessment, sediment and erosion control, water management and mine closure planning. Her project work spans several resource sectors including mining, pipelines, oil sands and forestry. She has contributed to conceptual mine drainage and water management plans, wetland designs and developed detailed operational plans for mine closure. Elisa’s experience includes hydrologic modelling, peak flow analysis, baseline flow monitoring, hydrometric instrumentation and site investigation. Her project experience includes geohazard assessments for pipeline watercourse crossings within the Peace River basin. She is currently the hydrology technical lead for BGC’s flood and geohazard risk review for Thompson River Watershed.

Shielan Liu, Ph.D.
Senior Numerical Modeller

Mr. Liu is a senior numerical modeller with over 18 years of international consulting and research experience in environmental and water resources engineering, with particular focus on hydroinfomatics. She is familiar with many of state of the art public domain and commercial hydrological/hydraulic/hydrogeological and geotechnical modelling packages. She has also designed and developed multiple batch modelling management and data pre- and post-processing programs, data management systems and web-based flood/landslide monitoring and warning systems. Her cross disciplinary expertise on hydrologic and hydraulics modelling, water planning framework architecture, and computer program development have been applied to multiple dam breach/flood/debris flow/tsunami risk assessment and management plan, mine closure plan and water management plan framework development projects. She is also an active reviewer for the ASCE Journal of Hydraulic Engineering and a member of the tailings dam breach working group for the Canadian Dam Association (CDA). Dr. Liu will act as team lead for hydraulic modelling for the project.

Dr. Rob Millar, Ph.D., P.Eng.
Principal Hydrotechnical Engineer and Technical Reviewer

Dr. Millar has 30 years experience in hydrologic and hydraulic design, river engineering, mine water management, dam safety (including many dam breach and inundation assessments), pipeline hazards, and erosion and sedimentation. He has a wide range of industry and academic experience in Canada, Australia, Alaska, South America, the Philippines, Romania, and Turkey.

From 1996 until 2012, he was a Professor of Hydrotechnical Engineering at the University of British Columbia where he taught undergraduate and graduate courses in open channel hydraulics, hydrology, river sedimentation, and computational modelling. During this time, he supervised 23 Master's and six Ph.D. students, and published over 70 journal articles, conference papers and book chapters. He continues to hold a position as Adjunct Professor at UBC.

Hamish Weatherly, M.Sc., P.Geo.
Principal Hydrologist and Technical Reviewer

Mr. Weatherly is BGC's team lead for the surface water discipline. He has more than 20 years of experience in his main areas of expertise which are hydrology, fluvial geomorphology, and hydraulic modelling (including floods, debris floods and debris flows). In addition, Hamish has completed extensive work on channel stability problems in Western Canada, with a particular emphasis on anthropogenic and natural influences on channel planform and sediment transport rates. His geomorphology expertise is complemented by his knowledge of river engineering including the integration of river morphology and flow hydraulics in assessing bank erosion and scour.

Patrick Grover, M.A.Sc., Ph.D. Candidate, P.Eng.
Senior Hydrotechnical Engineer and Technical Reviewer, Numerical Modelling
Mr. Grover has been involved in a wide range of water resources projects involving hydrotechnical engineering, geospatial information technology and software development for the past 15 years. He is a specialist in computational fluid dynamics and has completed hydraulic studies for a wide spectrum of flooding and dam breach projects in Canada and Asia. Patrick is on the Implementation Team for the RNT managing the ongoing maintenance and development of the system. Mr. Grover will act as technical reviewer for hydraulic modelling components of the study.

6.0 COST ESTIMATE SUMMARY

Table 6-1 lists estimated total costs for each major phase of the proposed work. The costs are divided across each District according to the proportion of area proposed to be mapped. BGC anticipates an approximately 8-month schedule to complete the proposed work. Standard conditions are included in Appendix A.

BGC is aware that some Districts may have already allocated part of their $150k funding application limit to other projects, which would change funding distribution. The budget breakdown and proposed mapping areas in this draft proposal are a starting point for discussion and may be revised once the potential application amounts are known. Once these are known, BGC proposes to keep with a $250k funding total if possible, and further adjust the budget breakdown across Districts based on mapping areas and the level of detail of study.

Due to efficiencies of scale, the cost estimates for each District are partially, but not entirely independent from each other. Specifically, if funding is not approved for Districts with the largest area to be mapped, work in the remainder of the Districts can still proceed. However, their final scope of work, budget and schedule would need to be confirmed after confirmation of funding.

Table 6-1. Flood hazard mapping budget estimate.

Project work plan/phase	Description	Budget				
		TNRD	CSRD	RDNO	Cariboo RD	Total
1	**Project Management**					
1.1	• Meetings, project management and administration	$15,217	$3,247	$4,056	$2,479	$25,000
2	**Data Compilation and Review**					
2.1	• Compile previous work including hydrologic imputs and existing hazard and asset data; incorporate any new LiDAR data.	$30,434	$6,494	$8,113	$4,959	$50,000
3	**Analyses**					
3.1	• Complete flood hazard identification, analyses and modelling; prepare outputs for flood hazard map deliverables, and update the regional study to reflect the new results.	$60,868	$12,989	$16,226	$9,917	$100,000
4	**Deliverables**					
4.1	• Draft and final report; flood hazard maps; data downloads or services; updated regional study web application.	$45,651	$9,742	$12,169	$7,438	$75,000
	Subtotal	$150,000	$34,641	$40,565	$24,793	$250,000
	GST (5%)	$7,500	$1,732	$2,028	$1,240	$12,500
	Total	$157,500	$36,374	$42,593	$26,033	$262,500

7.0 CLOSURE

We trust the above satisfies your requirements at this time. The information presented in this proposal document is proprietary and was prepared and submitted in confidence solely for consideration by Fraser Basin Council. The contents of this proposal document are not to be communicated, disclosed, duplicated, or distributed in whole or in part to anyone or any organization outside of BGC by Fraser Basin Council without the express written permission of BGC. Should you have any questions or comments, please do not hesitate to contact us.

Yours sincerely,

BGC ENGINEERING INC.
per:

Kris Holm, M.Sc., P.Geo.
Principal Geoscientist

Elisa Scordo, M.Sc., P.Geo.
Senior Hydrologist

KH/ES/HW/mj/admin

Attachment: Appendix A Standard Terms and Conditions

8.0 REFERENCES

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APPENDIX A
STANDARD TERMS AND CONDITIONS

SCHEDULE "A"

GENERAL CONDITIONS OF AGREEMENT
FOR PROFESSIONAL SERVICES AGREEMENT ("Agreement")

1. AGREEMENT

This Agreement consists of these General Conditions of Agreement, the attached Professional Service Agreement ("PSA"), (if the parties entered a PSA), and any addenda thereto, and collectively constitutes the parties' entire agreement. If the parties enter more than one PSA or future PSA's, these General Conditions of Agreement shall apply to each PSA. Unless otherwise agreed in writing, this Agreement supersedes any other agreement, contract or pre-agreement negotiations between the parties. All amendments to this Agreement must be in writing and signed by both parties.

2. DEEMED ACCEPTANCE

By receiving the provisioning of BGC's Services, the Client agrees to be bound by the terms and conditions set forth in this Agreement, whether or not the Client has signed an agreement or acknowledgment of the terms and conditions set forth herein, and the Client will thereafter be conclusively deemed to have accepted and to be bound by the terms and conditions set forth in this Agreement.

3. DEFINITIONS

Where used in this Agreement, the following terms have the meanings set forth below:

"**Affiliate**" has the meaning set forth in the British Columbia *Business Corporations Act*, SBC 2002, c. 57, as amended from time to time, and with regard to BGC, also includes subcontractors and sub-consultants BGC engages to perform the Services.

"**BGC**," "**Client**," "**Project**" and "**Services**" have the meanings set forth in the PSA or other relevant attachment to this Agreement. If not defined in the PSA or other attachment, or if the parties do not execute a PSA, "Services" means all work of all kinds that BGC performs for the Client, "Client" means the entity or person for whom BGC performs the Services, and "Project" means the Client's project related to the Services. Where appropriate, "Client" also includes Client's permitted successors, designees and assigns.

"**Claim**" means any claim, liability, action, demand, proceeding, judgment, lawsuit, legal action or cause of action, howsoever and whenever arising, whether present or future, fixed or unascertained, actual or contingent, and whether at law, in equity, under statute, for breach of contract, in tort (including negligence), for breach of warranty, strict liability or otherwise.

"**Damages**" means any and all losses, monetary and non-monetary damages, accidents, delays, costs, expenses (including, without limitation, legal fees, attorneys' fees, court costs, expert costs, investigative costs and disbursements), penalties, fines, assessments, liabilities (including any taxes and/or interest thereon), property loss (including any loss or damage to the Services, worksites or third-party owned property), personal injury (including death and disease), trespasses, general damages, property damage, or any other form of loss or liability.

"**Environment**" means all components of the Earth, including all layers of atmosphere, air, land and water, and all personal and real property (including all improvements and appurtenances) within, upon, under or over the foregoing;

"**Environmental Law**" means any applicable law, regulation, acts of public authorities, or code relating, in whole or in part, to the protection or enhancement of the Environment, or which imposes liability or gives rise to Claims or Damages as a result of adverse effects on the Environment;

"**Environmental Pollution**" means any deterioration of the Environment by harmful substances or otherwise, and which has to be remedied according to Environmental Law or relevant contracts;

"Intellectual Property" means intellectual or industrial property that is, might or could be protected by patent, copyright, industrial design, trade or service mark, or by similar means or applications therefor, and includes, without limitation, concepts, ideas, designs, inventions, devices, products, manufactures, deliverables, machines, methods, techniques, computer programs, algorithms, codes, software, processes, improvements of existing technology, or similar property in any other form, whether tangible or intangible, and whether reduced to practice or not;

"Personnel" means, in relation to a party to this Agreement or any other identified entity, all or any of the directors,

officers, employees, agents, consultants, and representatives of the party or entity;

"Pre-Existing Site Conditions" means the design, construction, nature and condition of all structures, earthworks and Environment on Client's worksite(s), including, without limitation, buildings, dams, berms, slopes, containment dykes, impoundments and earthen structures, areas maintained, placed, excavated, or in any manner or nature constructed or modified by Client or a third party, and in existence before BGC provided or provides Services on, for or about such worksite(s);

"**Unknown or Concealed Conditions**" means subsurface or other concealed physical conditions unknown to BGC and not reasonably foreseeable by BGC, including (1) conditions which differ materially from those described by Client to BGC including, without limitation, conditions relating to the design, construction or existence of Pre-Existing Site Conditions or pre-existing work by others, or (2) any other physical conditions at the worksite(s) which are unknown and not reasonably foreseeable by BGC; and

"Work Product" means documents, records, data, drawings, graphic representations, field notes, proposals, estimates, specifications, Intellectual Property in relation to a deliverable provided in connection with the Services, or other materials (whether in electronic, paper copy or other form) which BGC prepares and actually delivers to the Client as part of the Services.

4. SUB-CONSULTANTS/SUB-CONTRACTORS

BGC shall be entitled to engage any sub-consultants and sub-contractors for the performance of the Services or any part thereof as BGC believes is in the best interests of the Client or for the performance of the Services.

5. RIGHT OF ENTRY

The Client shall permit or arrange for permission, on a timely basis, for BGC and its sub-consultants/sub-contractors to enter onto, pass over, and perform the Services on all properties to which access is necessary for BGC to perform the Services.

6. INTELLECTUAL PROPERTY RIGHTS, WORK PRODUCT AND CONFIDENTIAL INFORMATION

(a) **Intellectual Property**. BGC shall retain sole and exclusive ownership of all rights for, in and to all Intellectual Property that BGC creates, invents, acquires or produces (including improvements, modifications and contributions to third party-owned intellectual property) while performing the Services or at any other time. BGC shall also retain sole and exclusive ownership of all Intellectual Property that BGC created, owned or conceived of prior to entering this Agreement, or which BGC in the future creates, acquires or conceives of independently of the Services (collectively, "**Non-Project BGC IP**"). If BGC includes any Non-Project BGC IP as a deliverable in connection with the Services, such inclusion shall only be considered a limited, non-transferable, non-exclusive and revocable license for Client to use such Non-Project BGC IP only for the Project contemplated hereunder. Notwithstanding anything to the contrary in this Agreement, BGC shall have the unrestricted right to utilize all its Intellectual Property in other contexts, including the rights to use its Intellectual Property for its own purposes and to grant licenses to third parties to use BGC's Intellectual Property. Unauthorized use, distribution, alteration, and/or sub-licensing of BGC's Intellectual Property by Client or third parties is strictly prohibited.

(b) **Work Product**. Upon full and final payment of all BGC's invoices for the Services, BGC shall grant the Client a limited, non-exclusive licence to use and reproduce all Work Product prepared by or on behalf of BGC and which BGC actually delivers to the Client in connection with the Services, provided that BGC shall retain exclusive ownership of all Intellectual Property shown, contained, used or disclosed in the Work Product. Any such limited licence to use and reproduce the Work Product shall be solely for the specific purpose(s) and projects for which BGC prepares or discloses the same. All other uses of the Work Product are strictly prohibited. Unauthorized distribution and alteration of the Work Product are strictly prohibited. All use of the Work Product is subject to BGC's "Limitations Statement" included with the Work Product. BGC shall have no liability for any Claims or Damages arising due to (1) any use of or reliance upon the Work Product by third parties or (2) any use of the Work Product for any project or purpose other than the specific project or purpose for which BGC generated the Work Product.

(c) **Trade Secrets and Confidential Information**. Client shall have no right to disclose, publish or publicize any of BGC's Intellectual Property, trade secrets, proprietary information or other confidential information (collectively, "**Confidential Information**") that: (1) BGC discloses to the Client on an expressly confidential or secret basis, (2) which Client ought to reasonably expect to be confidential, or (3) which BGC is known to treat as confidential.

Client agrees to protect and preserve the secrecy of all Confidential Information BGC discloses to Client, and to use BGC's Confidential Information only for the specific purpose(s) for which BGC discloses it to Client. Client shall only share BGC's Confidential Information with Client's Personnel who are reasonably required to be apprised of such information in connection with the Services. Client shall inform all of its Personnel to whom it may disclose BGC's Confidential Information that the information is strictly confidential, and that further dissemination of such information is strictly forbidden. If BGC so requests, Client shall require its Personnel to sign confidentiality agreements before Client discloses any of BGC's Confidential Information to such Client Personnel. Upon BGC's request or termination of this Agreement or the parties' business relations, Client shall immediately return to BGC all documents containing BGC's Confidential Information.

7. INSURANCE

While providing the Services, BGC shall carry the following insurance:

(a) such coverage as may be required pursuant to the applicable Worker's Compensation legislation, or satisfactory employer's liability insurance;

(b) Commercial general liability insurance for bodily injury and property damages in the amount of Two Million Canadian Dollars ($2,000,000.00 CDN) in the aggregate; and

(c) Professional liability insurance, which insures BGC against liability arising from negligent acts, errors, and omissions for which BGC may be responsible, in the amount of Five Hundred Thousand Canadian Dollars ($500,000.00 CDN) in the aggregate.

Certificates evidencing the required insurance coverages shall upon request be emailed to the Client. BGC makes no representations or warranties, whether express or implied, with respect to its insurance coverage or its insurance coverage availability or adequacy. BGC reserves the right to change its insurance from time to time in such manner as BGC considers prudent, including, without limitation, its carriers, coverage types, deductibles and policy limits.

Client shall carry the following insurance: (1) such coverage as may be required pursuant to applicable Worker's Compensation legislation (or satisfactory employer's liability insurance) and (2) commercial general liability insurance for bodily injury and property damages with coverage limits of at least Two Million Canadian Dollars ($2,000,000.00 CDN) in aggregate. Client shall name BGC as an additional insured on said commercial general liability insurance policy. Client may obtain additional or project specific insurance at its sole cost and responsibility.

8. PROFESSIONAL RESPONSIBILITY AND STANDARD OF CARE

BGC shall perform the Services with the normal level of care, skill and diligence ordinarily exercised by the consulting engineering profession at the time BGC renders the Services for services of a similar nature and under comparable circumstances (including, without limitation, time, financial, physical and other constraints) (hereinafter, the **"Standard of Care**").

9. NO OTHER WARRANTIES, REPRESENTATIONS, COVENANTS, OR GUARANTEES

Except as set forth under Article 8 of this Agreement, BGC provides no other warranty, guarantee, representation or covenant with respect to the Services or otherwise, either express or implied. BGC expressly disclaims all other warranties, whether express or implied by any means. BGC guarantees no particular results related to the Services.

10. LIMITATION OF LIABILITY, INDEMNIFICATION AND RELEASE

(a) EXCLUSIONS FROM LIABILITY AND INDEMNIFICATION. Client agrees to fully release, indemnify, defend and hold harmless BGC, BGC's Affiliates, and their respective Personnel from and against any and all Claims, Damages and other liabilities, howsoever caused or arising, whenever occurring, by whomever suffered or asserted (including third parties and government entities), and which arise, in whole or in part, directly or indirectly, because of:

(1) the negligence, malfeasance, errors, acts, omissions, breach of contract, breach of duty, breach of applicable standard(s) of care, or other fault of or attributable to the Client, the Client's other contractors, or any of their respective Personnel, whether directly related to the Services or not;

(2) the design of, or defects in, equipment, materials or other items supplied by the Client or its other contractors;

(3) any Claims or Damages arising because of Environmental Pollution; hazardous, dangerous or toxic materials or contaminants; or under Environmental Law, whether anticipated or unanticipated, and whether or not the Services were contemplated to include the discovery, release, escape, transportation, handling, analysis, containment, remediation, study or otherwise of such materials, contaminants, or Environmental Pollution, if such Claims or Damages are caused or contributed to, in whole or in part, by Client, Client's Affiliates, Client's other contractors, any other person or entity for whom Client is responsible and/or any of their respective Personnel;

(4) any damage whatsoever to subsurface structures and utilities;

(5) any Project decisions made by the Client if such decisions were made without BGC's advice or knowledge, or decisions which are contrary to or inconsistent with BGC's advice or policies previously communicated to the Client;

(6) disclosure by BGC of any confidential information relating directly or indirectly to the Client, the Project, the Services, or their subject matter that are or may be reasonably required to be disclosed by BGC or its Affiliates to comply with legal or ethical obligations;

(7) Third party work, Pre-Existing Site Conditions or Unknown or Concealed Conditions, whether such Damages are suffered by Client or third parties;

(8) Uninsurable Services requested or ordered by the Client;

(9) Infringement of any Intellectual Property rights by Client or its Personnel;

(10) Unauthorized disclosure of any Confidential Information belonging to BGC or any other third parties;

(11) Use of any Work Product for any purpose other than the Services or project for which Client hired BGC.

To the fullest extent permitted by law, the Client shall further release and hold harmless BGC, BGC's Affiliates, and their respective Personnel from any and all Claims and Damages Client has or may in the future have against one or more of them relating to or arising from Environmental Pollution, whether in contract, tort or otherwise, and whether arising directly or indirectly, in whole or in part, by reason of breach of contract, breach of duty, breach of the Standard of Care, negligence, errors or omissions by one or more of them.

(b) <u>BGC'S LIABILITY EXTINGUISHED</u>. To the fullest extent permissible under applicable law, any liability to the Client of BGC, BGC's Affiliates and their respective Personnel with regard to or arising from any and all Claims, Damages, or other liability related to the Services, shall absolutely cease to exist upon the expiration of one (1) year from the commencement of the applicable limitations period for asserting such claims in the state, province, territory or country where the Services are rendered. Client shall release and hold harmless BGC, BGC's Affiliates and their respective Personnel from and against any and all Claims, Damages (including legal fees and expenses) or other liability arising, claimed or asserted beyond the time period set forth in this paragraph, howsoever arising and by whomever suffered or asserted (including third party Claims and Damages). BGC shall not be liable to the Client for liquidated damages of any kind.

(c) <u>MUTUAL WAIVER OF PUNITIVE, EXEMPLARY, INDIRECT, INCIDENTAL AND CONSEQUENTIAL DAMAGES</u>. Notwithstanding any other provision of this Agreement, in no event shall either party to this Agreement be responsible or liable to the other party or the other party's Affiliates for any punitive, exemplary, indirect, incidental or consequential Claims or Damages in connection with this Agreement or the Services. Examples of such indirect, incidental and consequential damages include, but are not limited to, lost profits, lost revenue, loss of production, loss of business opportunity, business interruptions, costs of capital, business interruptions, loss of goodwill, loss of work, and loss of project use. BGC and the Client hereby release each other and their respective Affiliates from all liability for any punitive, exemplary, indirect, incidental and consequential Claims and Damages that may arise out of or in connection with the performance, purported performance or non-performance of this Agreement or the Services, howsoever caused, and whether due to breach of contract, tort (including negligence), strict liability or any other theory of liability at law or in equity.

(d) <u>ABSOLUTE LIMIT OF LIABILITY</u>. In consideration of the relative risks and benefits of the Services to both the Client and BGC, and subject to Sections 10(a), 10(b) and 10(c), the Client agrees that the total aggregate liability of BGC, BGC's Affiliates and their respective Personnel for any and all Claims, Damages or other liability arising with respect to the Services or under this Agreement shall be absolutely limited to TWO HUNDRED FIFTY THOUSAND CANADIAN DOLLARS ($250,000.00 CDN), in aggregate. Client hereby releases BGC, BGC's Affiliates and their respective Personnel from all liability that may arise in connection with the Services or this Agreement in excess of the aforesaid limitation amount. To the maximum extent permitted under applicable law, it is intended that this liability limitation shall apply to any and all Claims, Damages, liability or cause of action, howsoever arising, whether due to breach of contract, tort, negligence, breach of warranty, strict liability or any other theory of recovery or liability in law or equity, and by whomever alleged or asserted.

(e) In consideration of the Services provided by BGC, the Client waives and releases any right to assert any Claims against the individual Personnel of BGC or its Affiliates, no matter how such Claims may arise, even if due to the negligence, errors, omissions or other fault of such individuals. For the purpose of this paragraph, the word "Personnel" includes individuals in an employee/employer relationship with BGC, individuals who provide labour as independent contractors or who have any other contractual relationship with BGC whereby they provide labour, any corporate entities providing an individual's labour, and the individuals provided by any such corporate entities.

(f) Notwithstanding any other provision of this Agreement, if under this Section 10 or any other provision of this Agreement, Client is required to indemnify BGC, defend BGC, provide BGC representation, or otherwise negotiate with regard to Claims or Damages sought against BGC, BGC shall, acting reasonably, have the right to remain fully apprised of any such proceedings, to approve or disapprove of any proposed settlement, and to participate in or assume control of any such proceedings, including the right to select and hire its own defense counsel at Client's expense.

(g) The Parties agree that the limitations of liability and indemnification duties set forth herein were fairly negotiated between the parties. Client further acknowledges that Client had the option of altering or foregoing the limitations of liability set forth herein in exchange for an equitable adjustment of BGC's fees for the Services.

11. DEFICIENCIES REPORTING

The Client shall immediately report to BGC in writing any deficiencies, defects or suspected deficiencies or defects in the Services (the "Deficiency or Defect Notice"). It is agreed that the failure to do so may prejudice BGC's ability to properly investigate and analyse the cause of any such deficiency, and/or take effective measures to remediate and minimize the consequences of any such deficiency. If the Client fails to advise BGC in writing of any such deficiencies or defects within seven (7) days after becoming aware of or having a reasonable basis to suspect the existence of such deficiencies or defects, and if such failure to provide a timely Deficiency or Defect Notice hinders BGC's ability to investigate, correct or analyse any such deficiency or defect, then the Client shall be deemed to have waived and released all rights of action against BGC for Claims or Damages arising (in whole or in part) from any such alleged deficiencies or defects or to demand that BGC repair or address any such deficiencies.

If the Client delivers a Deficiency or Defect Notice to BGC, receipt of such notice shall not of itself modify or nullify any right to indemnification or any limitation of liability of BGC under this Agreement, at law, or otherwise.

12. NOTIFICATION AND DISCOVERY OF HAZARDOUS MATERIALS

The Client agrees that, if now or any other time, it knows or has any reason to assume or suspect that Environmental Pollution, hazardous materials, or contaminants may exist at the places where or for which BGC will perform Services or require access (the "**Site**"), then Client will immediately inform BGC in writing and by any other means necessary to immediately notify BGC of any such dangers (the "**Hazardous Materials Notice**").

The Client acknowledges and agrees that if Environmental Pollution, hazardous materials or contaminants are known, assumed or suspected to exist at or near the Site, BGC may be required to (1) protect the health and safety of its Personnel, the Environment and the public, (2) comply with all applicable laws and regulations, including Environmental Law, and (3) take other actions BGC deems prudent. The Client recognizes that if Environmental Pollution, hazardous materials or contaminants are discovered or suspected on the Site or on nearby property owned by others, then Client has a responsibility to inform BGC and the owner or occupant of such property of its discovery or

suspicion, and that such a discovery, suspicion or the resulting procedures adopted by BGC in providing the Services may reduce the property's value, and cause the Client additional costs.

The Client agrees that the discovery or suspicion of any Environmental Pollution, hazardous materials or contaminants on or near a worksite shall constitute a changed condition. Client agrees to compensate BGC for any additional Services BGC performs and any costs BGC incurs because of the discovery of Environmental Pollution or hazardous materials on or near a worksite, based on BGC's prevailing hourly rates and payment terms set out in this Agreement. If Environmental Pollution, hazardous materials or contaminants are discovered on or near the Site, BGC shall have the right to suspend the Services in order to protect BGC's Personnel. If BGC suspends the Services under this provision, the Client shall reimburse BGC for all reasonable costs and expenses BGC incurs in connection with such suspension, including costs to transport BGC Personnel from and back to the Site.

13. WITHDRAWAL/DISMISSAL OF OTHER PARTIES

If BGC engages one or more subcontractors to perform part of the Services, and if such subcontractor withdraws or is dismissed, BGC shall be entitled to select a qualified replacement, based on BGC's reasonable discretion. Promptly upon being advised of such replacement's identity, the Client, acting reasonably and stating its reasons, shall be entitled to object to such proposed replacement, whereupon BGC may select another replacement. In the absence of an objection from the Client within five (5) days after being notified of the replacement, the replacement shall be deemed acceptable to the Client.

14. EARLY TERMINATION OF SERVICES

The attached PSA (if any) or this Agreement may be terminated by either party upon thirty (30) days written notice to the other party. Either party may terminate the Services and the attached PSA upon ten (10) days written notice to the other party if the other party is in default of its obligations under this Agreement and has failed within five (5) business days after receiving notice to cure that default or take reasonable steps towards curing such default.

If a PSA or this Agreement is terminated for any reason, the Client shall forthwith pay BGC all amounts Client owes BGC, including all fees, expenses and other charges set forth in BGC's invoices, all expenses and obligations incurred or committed to by BGC in providing the Services, all fees for Services rendered but not yet invoiced, and for expenses reasonably incurred as a result of such termination. If the Client terminates this Agreement, BGC shall be entitled to complete, at the Client's expense, such analyses, records and reports as BGC considers reasonably necessary. Furthermore, if the Client terminates a PSA or this Agreement, then BGC, in its sole and reasonable discretion, shall be entitled to order or take all reasonably necessary actions to secure, protect and make reasonably safe the Services and Site(s) on which BGC provided Services for the Client, and the Client shall promptly pay BGC for all such costs and expenses, plus compensation at the rates set forth herein.

15. HIRING

Neither the Client nor its subsidiaries or Affiliates shall during the term of this Agreement and for a two (2) year period immediately following the termination of this Agreement, solicit or attempt to hire (including solicitation through a third party) any of BGC's or BGC's Affiliates' Personnel without BGC's express written consent.

16. ASSIGNMENT

Except as otherwise agreed in writing or as otherwise permitted within this Agreement, no party shall be entitled to assign its interest(s) or delegate its obligation(s) to any third party with respect to the Services, this Agreement and/or any addenda thereto. The parties' permitted successors and assigns, if any, are entitled to the benefit of, and shall be bound by, this Agreement.

17. FORCE MAJEURE

Except for obligations to pay money in connection with this Agreement, BGC shall not be in breach of this Agreement or responsible for any Claims or Damages caused by delay or failure to perform in full or in part its obligations under this Agreement, when such delay or failure to perform is due to any circumstance beyond BGC's reasonable control, including, without limitation:

(a) any consequence, event or condition arising because of inaccurate information, advice or instructions provided by the Client or any third party to BGC;

(b) any strikes, walk-outs, riots, unavoidable incidents, floods, fires, earthquakes, natural disasters, inclement weather, acts of God or a public enemy, or unavailability of or lack of transportation or suitable materials;

(c) any lawful order issued by a governmental authority or court with jurisdiction at the location in which the Services are being rendered (including denial, revocation or modification of necessary permits or licenses) which hinders, halts or adversely affects BGC's performance of its obligations hereunder; and/or

(d) any other unforeseen or unexpected contingency, event or condition.

Client shall reimburse BGC for all costs and expenses BGC incurs as a result of such Force Majeure events.

18. NOTICES

Required written notices between the parties shall be considered to have been received by the addressee on the date of delivery if personally delivered by hand during normal business hours to the addressee, to a member of the addressee's firm, or to an officer of the corporation for whom the Notice is intended. If sent by regular post, such written notice shall be deemed to have been delivered five (5) working days from the date of mailing. Notices sent electronically, by email or facsimile for example, are not considered reliable for purposes of official notice.

19. SURVIVAL

All obligations between the parties under sections 6 (Intellectual Property Rights, Work Product and Confidentiality), 10 (Limitation of Liability, Indemnification and Release), 11 (Deficiencies Reporting), 12 (Notification and Discovery of Hazardous Materials) and 15 (Hiring), shall survive and remain binding on the parties after the completion of the Services or any expiry or termination of this Agreement.

20. GOVERNANCE

Unless otherwise specified or prohibited by law, this Agreement shall be governed by the law of British Columbia, Canada, and the federal law of Canada applicable therein, and any and all disputes, Claims or actions shall be brought before the courts in the Province of British Columbia. Each party irrevocably submits to the exclusive jurisdiction of the courts of British Columbia, and waives any right to object to any action being brought in that jurisdiction.

21. PRIMACY

If the parties enter a PSA and if there is an inconsistency or contradiction between any terms or conditions set out within the PSA and those set out within these General Conditions of Agreement, the terms or conditions set forth in the PSA shall govern to the extent of any contradiction or inconsistency, provided that section 10 (Limitation of Liability, Indemnification and Release) of these General Conditions of Agreement shall govern any conflicting or contradictory term(s) set forth in a PSA.

22. NO WAIVER

Except with regard to Section 11 (Deficiencies Reporting), or as otherwise expressly set forth in this Agreement, a party's waiver of any breach of the other party's obligations under this Agreement shall not be binding unless the waiver is in writing and signed by an authorized representative of the waiving party.

23. DISPUTE RESOLUTION

The Client and BGC shall make all reasonable efforts to resolve any dispute between them by amicable negotiations, and to provide, on a "without prejudice" basis frank, candid and timely disclosure of relevant facts, information and documents to facilitate those negotiations. If a dispute arises, the Parties shall promptly schedule a meeting between individuals from each party who have decision-making authority sufficient to bind the parties, and to attempt good faith negotiations regarding the dispute.

If thirty (30) days after such initial meeting, or such earlier or further period as agreed to by BGC and the Client in writing (the "**Negotiation Period**"), BGC and the Client have not succeeded in negotiating a resolution to the dispute, then BGC and the Client shall submit the dispute to mediation. The parties shall attempt to jointly appoint a mutually acceptable mediator. If the parties are unable to agree upon the appointment of a mediator within seven [7] days after the end of the Negotiation Period, the parties must apply to the British Columbia Mediator Roster Society, or its successor body, or such other organization or person agreed to by BGC and the Client in writing, which will appoint a mediator, taking into account:

(a) the need for the mediator to be neutral and independent;

(b) the mediator's necessary qualifications;

(c) the mediator's fees;

(d) the mediator's availability; and

(e) any other consideration likely to result in the selection of an impartial, competent, and effective mediator.

If the Client and BGC are unable to resolve any dispute between them through mediation, then if mutually acceptable to both parties, they can refer the matter to binding arbitration. Any such arbitration shall be administered by the British Columbia International Commercial Arbitration Centre ("B.C.I.C.A.C") and Mediation Institute in accordance with its procedures for cases under the B.C.I.C.A.C. Rules, except where those Rules conflict with the provisions of this Agreement, in which case the provisions of this Agreement shall govern. Any such arbitration shall occur in Vancouver, British Columbia. If the parties refer a dispute to arbitration, the arbitrator's decision shall be final and binding on the Client and BGC.

Except as may otherwise be required under this Agreement, each party shall bear its own costs and attorney's fees in mediation or arbitration hereunder, and the mediation or arbitrator fees and costs shall be split evenly between them.

24. INVOICES

Notwithstanding any provision to the contrary herein, if Client fails to compensate BGC for the Services or to reimburse BGC for its reasonable expenses incurred in connection with the Services, and BGC is required to file suit against Client or initiate other collection proceedings, BGC shall be entitled to recover from Client its reasonable attorneys' fees and costs incurred in so doing.

All invoices are due within thirty (30) days after BGC presents Client with an invoice. Amounts overdue by more than thirty (30) days shall thereafter accrue interest at the rate of eighteen percent (18%) per annum, or the maximum rate permissible under applicable law.

25. SEVERABILITY

If any provision of this Agreement is declared by a court of competent jurisdiction to be invalid, illegal, or unenforceable, such provision shall be severed from this Agreement and the other provisions shall remain in full force and effect. If only part of a provision of this Agreement is invalid, illegal, or unenforceable, any such part shall be severed from the provision, and the remainder of the provision shall remain in full force and effect. If a provision is invalid, illegal, or unenforceable, the parties shall endeavor in good faith to agree upon a substitute provision that is as near as possible as the parties' original intent.

26. HEADINGS

All headings in this Agreement are for convenience only, and shall not be used to interpret this Agreement.